

# NATURAL HISTORY

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AMERICAN MUSEUM OF NATURAL HISTORY

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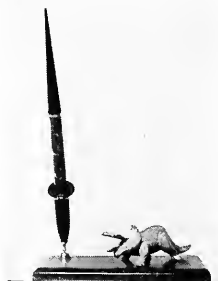
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# LETTERS

## Award

SIRS:

At the executive meeting of the Judging Committee for the 1947 AAAS-George Westinghouse Science Writing Awards, the article entitled "Life of the Water Film," published in your June, 1947, issue of *NATURAL HISTORY* and written by Dr. and Mrs. Milne, was cited for honorable mention.

The judges were very high in their praise of this article and expressed great satisfaction that it was possible for such an article to appear in print through the medium of your publication. In consideration of the excellence of the article and its presentation, the Judging Committee voted to award a citation to *NATURAL HISTORY* Magazine for distinguished science journalism in magazines during 1947. . . .

THEO. J. CRISTENSEN,

*For the Managing Committee.*

American Association for the  
Advancement of Science,  
Washington, D. C.

## Glaciers at Home

SIRS:

We certainly enjoyed Professor Flint's article on glaciers in the October issue. And his pictures were superb. May we add a postscript in defense of the many smaller glaciers in the United States and Canada?

Recently we visited a few that were within driving distance and found them well worth the trip. One, the Columbia ice fields between Alberta and British Columbia, occupies 150 square miles of territory straddling the Continental Divide, and it sends down tongues of ice that melt to gush into three oceans: by way of the Columbia River to the Pacific, via the Saskatchewan River and Hudson Bay into the Atlantic, and through the Mackenzie River into the Arctic.

One of these tongues is the Athabasca Glacier, 80 miles from Lake Louise up the Banff-to-Jasper highway, reached by a fairly good road. We parked within calling distance and took a good look at it. In fact, you can climb up on the Athabasca Glacier and observe the clear streams that gurgle down the ice on sunny days. Or you can climb down and peek under the end of it, into huge ice caves

*Continued on page 42*

➤ BETWEEN TWO JAGGED MOUNTAINS, the Athabasca Glacier extends a tongue to within a few hundred yards of the highway between Banff and Jasper, Alberta. Small streams cut into the snow top of the ice field, but it is easy to walk up on the slanting shelf of ice



▲ MOUNT RAINIER is a stump-shaped remnant of an old volcano, capped with a great glacier having tongues down all sides. One of these melts to form the greenish-gray Nisqually River which rushes past the campground of the National Park area

*Photos by Lorus J. and Margery J. Milne*



# 1947



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# NATURAL HISTORY

*The Magazine of the American Museum of Natural History*

FREDERICK TRUBEE DAVISON, President

ALBERT E. PARR, Director

VOLUME LVII—No. 1

JANUARY, 1948

A Night-Blooming Cereus.....Cover Design  
*From a Kodachrome by Glen and Elsa Scott*

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*Industrious, intelligent, and attractive, the Desert Rat is a decidedly worth-while animal*

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Arizona's First Land Rush.....Nell Murbarger 37  
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Owl Quintuplets.....Hugo H. Schroder 45  
*The Florida Burrowing Owl poses patiently for the photographer*

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## THE COVER THIS MONTH

This spectacular flower is one of several that receive the name "night-blooming cereus." The term is rather loosely used for several genera of cacti that open their large flowers at night. The cactus shown (*Hylocereus*) is one of those most commonly grown in warm regions. Perhaps the most famous of these plantings is the half-mile hedge of *Hylocereus undatus* in Honolulu, where as many as 5000 flowers open in a single night, producing a spectacle that draws hundreds of visitors.

It is unfortunate that such a splendid flower lasts but a few hours. The tremendous buds do not unfold until darkness has arrived. Then comes the brief period of almost breath-taking beauty, with the graceful, satin-textured petals and golden stamens exposed to form a bloom of startling size. It seems incredible that the sprawling, angular stems armed with scattered spines could produce such a flower. The one photographed was grown by Mr. and Mrs. Louis M. Roberts of Encinitas, California, who specialize in unusual and interesting flowers of this type.

The species of *Hylocereus* are native to the West Indies, Central America, and northern South America. Because of their attractive flowers, these cacti have been carried around the world. This has resulted in the strange fact that the original specimen of *H. undatus* on which the scientific description was based was found in China!

HAROLD E. ANTHONY.

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Atherlie E. Karp, *Editorial Assistant*.

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# YOUR NEW BOOKS

BIRDS • CACHE LAKE COUNTRY • DESERT  
SUNSPOTS IN ACTION • MIND AND BODY

## CACHE LAKE COUNTRY

----- by John J. Rowlands

Illustrated by Henry B. Kane

W. W. Norton and Co., \$3.50

272 pp., 36 full-page illust. and numerous spots

MANY people are frustrated in their desire to live for a while in the wilderness where they can enjoy the wild-life and the beauty of forests unspoiled by man. The fact that hunting, fishing, and camping are such popular pastimes is evidence of the fact that many of us enjoy this type of life.

Fortunately, for those who cannot find the time or means to go to far-away places, there is some solace in reading about the experiences of people who have lived in the wilderness. Both the stay-at-homes and the travelers will enjoy the story of life in the North Woods as it is told in this book.

The author includes a wealth of wood-craft information. The reader will learn how to build various types of shelters, how to make camp gadgets (including many clever devices that can be made with scraps of material found about the cabin), and what food to take along. Sportsmen and Boy Scouts will find such information very useful. Henry B. Kane's attractive drawings will delight the reader and assist him in executing the author's "how-to-do-its."

The pleasing manner in which the author combines his explanations of camp-life with his well-expressed observations of life in the woods makes *Cache Lake Country* a book that can be appreciated by all nature lovers. The drawings capture perfectly the feeling of the North Woods.

GEORGE F. MASON.

## FIELD GUIDE TO BIRDS OF THE WEST INDIES

----- by James Bond

Illustrations by Earl Poole

The Macmillan Co., \$3.75

257 pp., 211 illust.

JAMES BOND, our leading authority on West Indian birds, has based this field guide on his earlier, more technical, and now unavailable volume on this subject. All the numerous North American birds that migrate to or through the West Indies, as well as the resident species, are briefly described, and most of the latter

are figured. The songs, call notes, and habits of the native birds are given, and where unknown, the need of further observation is emphasized. In addition to the scientific and English names of the birds, the names used by the residents of the islands are given. In recognition of a common plea of field students, subspecies are omitted from consideration altogether. With the exception of a few secretive or obscure species, this guide should make identification relatively easy even for the novice making his first visit to the West Indies.

Two families and many species of birds are found only in the West Indies. Many of these have very limited ranges. The Zapata Swamp in Cuba, for example, is the home of three peculiar species found nowhere else. These localized birds are highly vulnerable to such adverse factors as deforestation, hunting, and the introduction of cats and mongooses. Several West Indian species are already extinct, and others, including some beautiful parrots, are endangered. Fortunately, some of the most distinctive species, like the curious little Tody, figured in a colored plate, are more widespread and common. This excellent book, as its author hopes, should awaken interest in the conservation as well as the study of West Indian birds.

DEAN AMADON.

## POISONOUS DWELLERS OF THE DESERT

----- by Natt N. Dodge

Southwestern Monuments Association,

Sante Fe, New Mexico, 50¢

44 pp., 28 illust.

ASSEMBLED in this bulletin are readable and accurate accounts of the venomous animals of our southwestern deserts. Descriptions and illustrations of the animals, the symptoms of their bites or stings, and recommended treatments are included, as well as various precautions that can be taken to prevent injury. Such occasionally bothersome insects as ants, honeybees, and kissing bugs are treated and also a few completely harm-

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less creatures mistakenly believed to be poisonous.

The deservedly notorious animals are the rattlesnakes and scorpions, and these latter are reputed to cause more deaths in Arizona "than the bites and stings of all other creatures combined." Few people realize that two Arizona scorpions are capable, as are similar kinds in Mexico, of causing death in young children and grave symptoms in adults. The rattlesnakes and other venomous reptiles are relegated to secondary importance, a conclusion to which the writer would not subscribe without published statistical evidence. The bringing together of much authoritative information on poisonous animals, with the aim of dispelling unwarranted fears among prospective park visitors, may well have the opposite effect of magnifying the importance of the relatively few noxious or dangerous inhabitants of our deserts.

W. J. GERTSCH.

## MIND AND BODY: PSYCHOSOMATIC MEDICINE

----- by Flanders Dunbar

Random House, \$3.50

263 pp.

PSYCHOSOMATIC medicine is a new name for a very old thing. As far back as Hippocrates, and no doubt farther if records were available, the influence of unresolved and sustained emotion and mental conflict upon the health of the body was a recognized reality. In the Middle Ages, the devil was exorcised from the soul in order to relieve the body of its physical ailments. It is only in modern times that this ancient wisdom has fallen into neglect and that the source of all physical diseases and disturbances has been sought in the disorganization of the bodily functions themselves. Recently, a group of psychiatrists, primarily concerned with emotional and mental conflicts, have once more become impressed by the unity of mind and body and have traced various bodily sicknesses to mental origins. The branch of medicine that has developed around this conception has been called psychosomatic—literally, mind and body.

Dr. Dunbar is one of the leaders in this field, which is young enough for her to be also one of its pioneers. She has presented in this witty, freshly written book a popular summary telling what

ences in ionization in these layers upon radio transmissions of both high and low frequency, and he points out how it has become possible for radio engineers to predict the frequencies that may be used for long distance transmission and those that will be affected by sunspot activity.

But he does all this in such an interesting and entertaining manner—well, let's let him tell it! GORDON A. ATWATER.

## FLASHING WINGS

----- by Richard M. Saunders  
McClelland and Stewart, Toronto, Ont.,  
\$4.50

388 pp., 37 illust.

DR. SAUNDERS, a professor of history at the University of Toronto, is also one of Canada's most ardent bird watchers. In this handsome volume he has brought together from his extensive notebooks the more significant or unusual observations recorded over a period of several years. One chapter is devoted to each month of the year, perhaps the best method of arranging such material. The result is virtually a guide to birding in the Toronto region, interspersed with accounts of occasional trips to northern Ontario or to the United States. Two maps designed especially to include the areas mentioned aid in reading the book. There is a table of migration dates and another that summarizes the results of annual Christmas bird censuses in and about Toronto over a period of 20 years. The illustrations are the work of the well-known Canadian bird artist, T. M. Short.

From the above it is evident that *Flashing Wings* will be of greatest value to residents of Ontario. The Toronto region has an unusually varied bird life (327 species have been recorded). Lake Ontario moderates the climate, permitting Cardinals, Carolina Wrens, and other southern species to survive. Many water birds are also attracted to this area. In the winter, Three-toed Woodpeckers, Canada Jays, and other boreal birds occur, at least in small numbers. Nesting Holboell's Grebes and Leconte's Sparrows add a western element absent elsewhere in the east. Dr. Saunders' notes on the habits of many of these infrequently observed birds will be read as eagerly by field ornithologists of the northeastern United States as by those of Canada.

D. AMADON.

## DESERT PARADE

A Guide to the Southwestern Desert  
Plants and Wildlife

----- by William H. Carr

The Viking Press, \$2.50

96 pp., 26 pp. of illust.

LET it be said at the outset that this is a book for those who do not want to know *all* about the desert plants and animals. It was drawn up with the avowed

## SEA AND LAND SHELLS

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WALTER F. WEBB

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intent of hitting the high spots. In less than 100 pages, including 26 of photographs, it deals with slightly more than 90 animals and about half as many plants. These include mammals, birds, reptiles, a few insects, and such miscellaneous invertebrates as scorpions, centipedes, and spiders. Approximately a third of the book deals with the common trees, shrubs, and flowers, with a chapter devoted to the cacti.

By and large, Mr. Carr has selected the common animals and plants that the desert traveler is likely to note or to be curious about for one reason or another. In many instances they can be identified by means of the 74 generally excellent photographs, and additional notes in the text may help. When there is only a brief description and no photograph, the user is likely to have difficulty. The "keys to species" that usually characterize handbooks are omitted, probably on the correct assumption that they are used only by the initiated.

The text includes brief notes on animal

survival, the characteristics of deserts, modern living in such regions, and a not very inclusive list of "some useful books." The reader is quite properly referred to one of these, the *Field Book of Snakes* by Schmidt and Davis, for information concerning the treatment of snake bite. It is evident that Mr. Carr did not consult the book very carefully himself, since the snake he depicts as a diamond-back is a Mojave rattlesnake. Nevertheless, the book is generally accurate. It may satisfy the needs of the traveler who wants some understanding of the desert but hasn't the time or the inclination to learn all that's known.

C. M. BOGERT.

## THE AMPHIBIANS AND REPTILES OF THE PACIFIC STATES

----- by Gayle Pickwell

Stanford University Press, \$4.00

236 pp., 85 illust.

IT has often been pointed out that the student of natural history is interested in four principal questions concerning an animal: (1) What is it? (2) Where does it live? (3) What does it do? (4) How does it do it?

Most of the handbooks that have appeared during the last decade have at-

Continued on page 42



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▲ THE FRUITING BRANCHES of *Cinchona calisaya*, native to southern Peru and Bolivia. A rich strain of this species was the parent of the monopolistic cinchona industry of Java, in the Far East

THE bark of the cinchona tree is the only known natural source of quinine, renowned the world over as the original drug for treating malaria. Java, in the Netherlands East Indies, produces over 95% of the world's quinine bark. When this island with its cinchona plantations was conquered by the Japanese early in World War II, the United States faced a possible quinine shortage. Never before had the need for this antimalarial been so great, for thousands of our troops would be fighting in tropical or subtropical regions where this fever is rampant. Cinchona bark thus became a high priority commodity.

The War Production Board required all major distributors to turn their quinine over to the government, and a considerable quantity was added to the stock pile

the government had gathered before Pearl Harbor. But the war might be a long one, so it was imperative to explore all possible sources outside the Netherlands East Indies.

Luckily for us, cinchona trees are immigrants in Java, having originally come from South America, where they are to be found growing wild in the wet forests that cover the eastern slopes of the lofty Andes. It was from trees in Peru and Bolivia that Java received the tiny, winged seeds from which her famed plantations were developed in the middle of the last century. With a wartime crisis in quinine, field parties, under the direction of the U. S. Office of Economic Warfare, were quickly formed and sent into this old cinchona territory. A botanist and a forester formed the backbone of each of these groups. Their job was to search the eastern slopes of the Andes for wild cinchona trees, to determine the types of trees present, to estimate the quantity and quality of bark available, and to give suggestions for the best methods for its quick exploitation. These groups were in the field for nearly three years (1942-1945), and they combed inaccessible mountain forests from Venezuela to Bolivia.

For many years certain of the Andean countries (especially Ecuador, Peru, and Bolivia) have harvested insignificant amounts of cinchona bark. The grade of bark selected has necessarily been the best wild type available, because it has had to compete with the exceedingly rich strains developed through careful selection and breeding on the plantations of Java. Even so, the very best wild barks, ranging up to an 8% content of quinine sulfate, could hardly match the cultivated forms, which at times reached a content of 15%, or 15 pounds of quinine salt per 100 pounds of dry bark.

The result was that the finest grades of cinchona bark in South America had largely been depleted, and in the war emergency the low-grade barks from normally non-commercial species (of which very fortunately there was a bountiful supply) had to be used. These species served as able "pinch hitters" for Java bark.

They included pitayo bark (*Cinchona macrocalyx*) and cupreine bark—the only quinine-yielding non-cinchona (*Remijia* spp.). The latter originally came from Colombia. Then there was the famed red bark (*C. succirubra*), native of the Andean slopes near the foot of Ecua-

## *Reminiscences of a* **CHICHONA HUNTER**

Adventures in the far forests of the Andes  
in search of emergency sources of quinine

By WALTER HENRICKS HODGE  
*Associate Professor, University of Massachusetts*

*All photos by the author*

dor's giant Chimborazo and the gray barks called *huanuco* and *monopol* (*C. micrantha*) of Peru. The latter species did not even produce an ounce of quinine in its bark, but it was rich in cinchonine, a related alkaloid, valued in the manufacture of totaquine. But the best of all wild quinine-yielding species, *calisaya* (*C. calisaya*) of southern Peru and Bolivia—the species from which many of the Java strains were developed—existed in such small quantities that its importance in the wartime industry was negligible. Of more interest for the future of cinchona breeding on present plantations was the discovery in northern Peru of a little-known species whose bark runs higher in quinine than wild *calisaya*.

Peru's best cinchona stands are located in the southeastern corner of the country where the gold-laden waters of the Tambopata and Inambari Rivers—Peru's twin "Yukons"—first begin to tumble and plunge down through the precipitous canyons dissecting the high Andean country east of the Titicaca basin. It is the type of breath-taking and scenic country that the United States Park Service would insist on being made into a National Park. The best commercial species of cin-



▲ A PATH near Huancabamba, in northern Peru, gives one a glimpse of the spacious scenery encountered in Peru's rugged cinchona country



◀ COLLECTING the tiny, winged cinchona seeds for use in developing a New World industry. Nearly a century ago, smuggled seeds from Bolivia and Peru became the basis of the fabulous plantations of the East Indies, source of 95% of the world's quinine. World War II forced the United States to repeat the long, slow task of collecting new seeds and setting up cinchona plantations in the Western Hemisphere



◀ **SAMPLING** cinchona bark. Samples were taken from different levels of the trunk to allow for variations in the distribution of the alkaloids. If the bark proved good, exploitation of the region was started

chona grow from about 3000 feet up to timber line, around 10,000 feet. Thus one is in fairly high country, far above the not-so-distant lowlands where the wartime search for wild rubber went on.

The rivers here are not yet deep enough to aid in water transport; in fact, one can get about only on foot or with mules. There is abundant precipitation: the rainfall may average 150-200 inches a year. The forests are lushly verdant, with innumerable types of evergreen trees, palms, and tree ferns, all supporting abundant epiphytic plants. This is true mountain rain forest, the fountainhead of most of the main western tributaries of the Amazon. The air, though humid, is tempered by the elevation, so that there is a beautiful climate in which to work. And as though unable to exist in the vicinity of quinine-producing cinchona trees, malaria and other lowland tropical fevers are generally absent.

What was a typical day like on a wartime cinchona survey? Let's transplant ourselves to a forest bor-

dering the rock-tumbled banks of the Huari-Huari, one of the ultimate tributaries of the Inambari. It is daybreak: "Daylight in the swamp," says the forester. I grunt and doze off again until he adds, "Fire in the mountain; roll out or roll up!" Reveille for the quinine hunter, and it's just as bad as a huge call when it comes at 5:30 A.M.

Dawn in the Peruvian Montaña (the tropical forest area of eastern Peru), much as I have hated to admit it, is really the best time of day. From out of the wet forest behind the tent comes the squawk of a *tunki* (*Rupicola peruviana*), a red-and-black version of the cock of the rock. A pair of parrots, silhouetted black against the lightening sky, pass by in a typical tight-wing formation.

"This hour, though beautiful, is made for sleep," I think, remembering the grueling 30-miles, up-and-down mountain hike of the previous day. Nevertheless, I push back the blanket and sit up very cautiously. One has to be cautious, for our

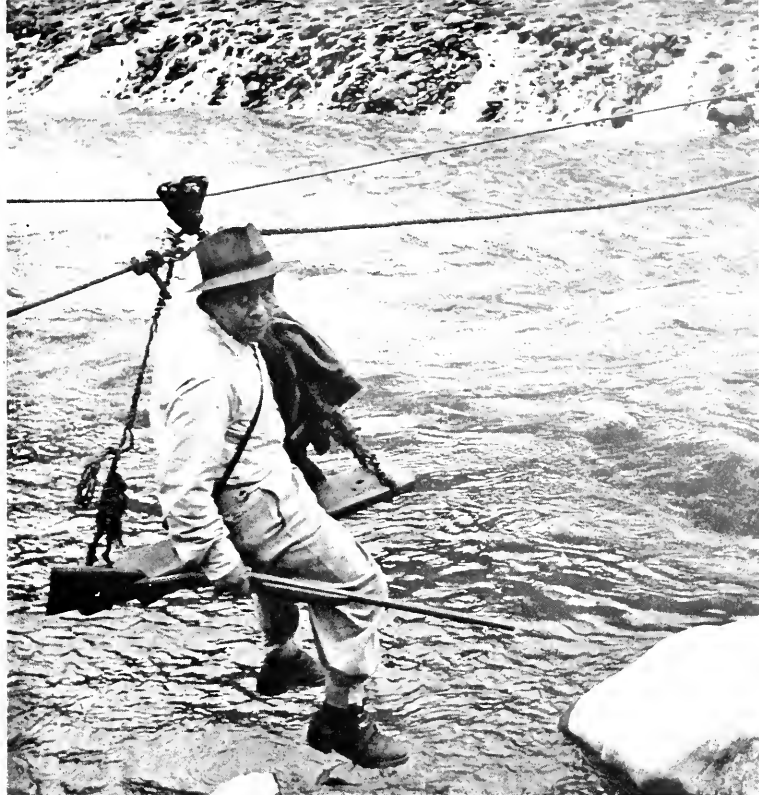
poorly constructed camp cots collapse at the slightest suggestion. Our forester found himself on the ground the first time he sat on his cot, and now he sleeps each night with the expedition hammer propped under the weaker corner.

The forester already has the pressure stove set up, and the "Quahker" (as Quaker Oats are universally known in Latin America) our standard breakfast dish, is gurgling away in its pot like lava in a volcanic crater. Our Peruvian assistant is halfway inside his duffel bag looking for something; a standard joke of our group is that fully half our time is spent inside the duffel bags hunting missing articles of apparel. Out by the brown-colored river stands another member of the party, half-dressed, looking himself over carefully for fleas, which he says are "as big as footballs." Inseparable companions in many parts of Latin America, they are the principal distraction during the night.

At 6 A.M. breakfast is served. Soon afterwards our Quechua Indian carriers appear from their near-by



▲ A VARIETY relatively poor in alkaloid but very common: "colorada" (*C. pubescens*), a large cinchona of the Andean forests of northern Peru



bivouac. They are anxious to get their loads ready for the day's trip. These are not lowland forest Indians but rather a highland race—big-chested descendants of the ancient Incas, as sure-footed and almost as strong, it would seem, as mules. They speak their own dialect, and in order to communicate with them our foreman, or *capitas*, must speak both Spanish and Quechua. Besides their baggage and food (chiefly parched corn, dried banana chips, desiccated potato *chuño*, and a locally salted, dry mutton called *chaloná*), each Indian daily backpacks up to 70 or 80 pounds of our camp equipment. He will lug this for 20 to 30 miles over as rough a mountain country as one would ever want to see—all for a daily wage of about 32 cents (U.S.) plus a ration of dried coca leaves. When our group was first initiated to cinchona-land, we were so worn out after the first day that we were almost tempted to adopt the Indians' coca-chewing habit. Coca leaves contain the narcotic cocaine, and the chewing of them deadens fa-

▲ TO TRAVERSE impassable mountain torrents, cinchona hunters use a modern cable (*oroja*), which has replaced the old Inca type woven from fibers. Inambari River

► A FORESTER measured the trees to estimate the quantity of bark available from a given area. *C. micrantha*, photographed in the mountain forests near Tingo Maria

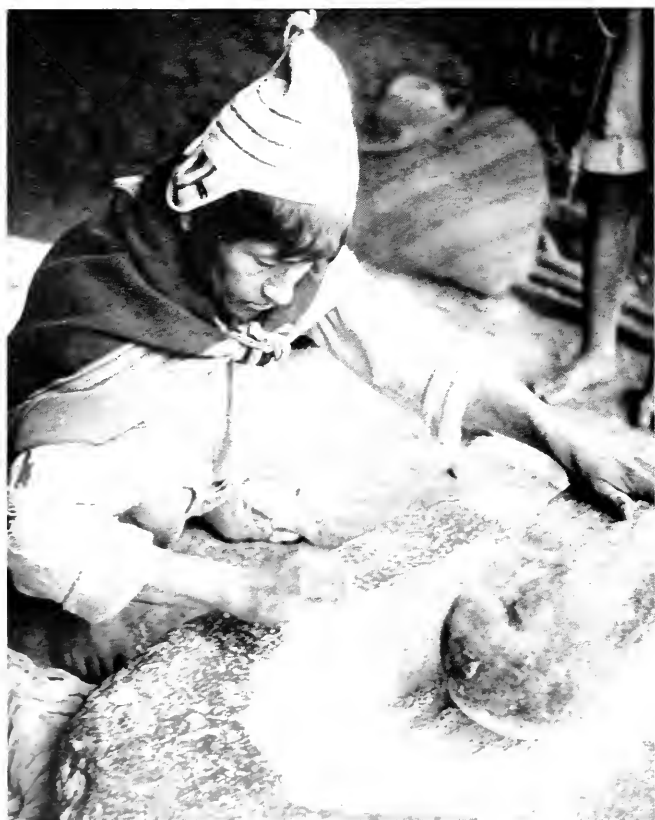




◀ MANY DAYS in the saddle were often required to reach the cinchona country. This mile-deep chasm, the Utrubamba Gorge of northern Peru, had to be crossed several times en route to and from *cascarilla* country



▲ WASTEFUL EXPLOITATION. *Cascarilleros* of the Inambari region harvested only a small proportion of the bark of this specimen of *Cinchona micrantha* and in so doing have lost money. The alkaloidal content in this species is more concentrated higher up on the trunk



▲ ONE of the author's Quechua Indian carriers making banana flour from his stock of dried banana chips. He uses a crude "rocking-type" grindstone. He is dressed in homespun, with wool poncho and stocking hat, or *chullo*

tigue and hunger on long jaunts through rough mountain country.

With camp disbanded and our Indians loaded, 7 A.M. has drawn around again! We will hike through the forest, recording on special form sheets all cinchona trees spotted within a ten-yard limit along one side of our path. The trees will be listed according to species and estimated diameter of the trunk at breast height. In this fashion we make what is known as a strip traverse—a sort of narrow sample of a given area. By means of this we can get a rough estimate of the amount of bark available from each of the species of cinchona native to the region, because from previous work we have learned how much





◀ BACK IN AREQUIPA, bark samples were dried as shown here. The humidity of the forest made thorough drying in the field camps impossible. El Misti, Arequipa's guardian peak, is seen in the distance

▼ THE CINCHONA BARK is stripped from the living trees with machetes, partly dried in the sun, and bound up in 50-pound bundles as shown here. High-grade bark like this is worth about fifteen U. S. dollars per hundred pounds to the bark hunter



bark any given diameter of tree will yield. Using these simple but effective methods, we are able to estimate fairly well the amount of dry cinchona bark that any area will yield. And by knowing the local costs for harvesting and transporting it, we can definitely state whether a newly discovered area is commercially worth-while or not.

As a botanist whose task it is to spot and identify the various species on our daily grind, I start out ahead. Close behind me is the tally man, who keeps written record of all trees noted. Filling in the rear is the forester, who by means of an automatic counter carefully paces the amount of territory daily traversed. "*Monopol* [*Cinchona micrantha*], fourteen inches," I call out, and the tally man repeats it as he enters it on the sheet.

At every kilometer, altitudinal or other data are recorded, and a new sheet is begun. In this way we not only learn the exact location of especially valuable stands but also gain an idea of the natural habitat and preferred altitude of the various species encountered.

Like all other trees in a tropical rain forest, cinchona trees are never evenly distributed but grow in isolated little groups, which the Indians call *manchas*. These are often

distant from one another. For long intervals, therefore, there is often silence in the party, broken only by the sounds of hobs striking stones or of the squish-squash of wet leather in a muddy stretch. Our daily survey invariably has its ups and downs, for forest trails, when existent, follow the whims of the hunters that made them—now close to a river, now up a nearly vertical slope, over a mountain ridge, and then down. It was not uncommon to climb and descend the equivalent of three or four 5000-foot ridges in an average day's traverse of fifteen to twenty-five miles. A single two-week trip could cover over 200 miles in a country that one old American miner has described as "a land of vertical plateaus." It is little wonder that shoes finally give up the ghost. On the rocky trails of southern Peru, a tough pair of Army GI shoes lasted a cinchona hunter for little more than two weeks to a month. The feet enclosed usually felt "done out" long before.

But we were living on the western fringes of the great unspoiled Amazon wilderness, a land that harbored inexhaustible yet largely unknown material for the nature lover or scientist. And to us who had to keep on the move, the greatest disappointment was to have to

pass up this or that exotic plant. We could not give the time we wanted to the queer animals of the forest around us or to the lore of the forest aborigines who occasionally wandered into our lives. Some of our forest companions were mere sounds to us, such as the troops of red Howler monkeys, whose concerted roars echoed and re-echoed at daybreak through the narrow valleys like a bloodcurdling alarm-clock. The Howlers kept well out of sight, but now and then we



▲ A MULE with a load of cinchona bark from the forest country crosses a crude bridge over the upper Inambari—the start of a long, hard climb over the Sierra



▲ SIERRA INDIANS carrying 85-pound packs for cinchona survey groups

would catch glimpses of a tumbling treetop assemblage of black Woolly Monkeys, often accompanied by little Capuchins, traveling through the forest. Again we would see the bold imprints of the inquisitive tiger cat, or ocelot, or the worn trails of the *danta*, or tapir, leading in unvarying regularity to and from the rushing streams, where these large animals apparently love to submerge, possibly to get away from insects.

Our daily surveys were not without their amusing incidents. Two of us with a guide came around a bend in a forest trail one day to find a glade crowded with a herd of White-lipped Peccaries, called by the natives *javalí*. There were certainly a hundred of the beasts, yet not one of them had noted our ap-



▲ A BURRO weighed down with "quills" of cinchona bark, wrapped in crude packs

proach. Being short of meat rations, we mentally chastised ourselves for not having our guns with us. As we stood watching all those nice pork tenderloins root around in the clearing with not a care in the world, the herd suddenly became aware of our presence. The air filled with doglike growls and with the clicking and gnashing of their short little tusks, as they crashed off into the forest. All but one, that is. We had advanced to the glade when we spotted what appeared to be an

old boar, probably a sentinel for the herd, standing in the trail 100 yards from us. He didn't remain still long after sensing our presence but started streaking toward us at top speed.

None of us was in an arguing mood. The guide and I climbed a steep bank at the side of the trail and when safe turned to see what was happening. Our forester was breaking all records for short distance sprints as he navigated that stretch of trail, his rain cape whipping in the breeze behind him. But from our position we could see it was no use. The old boar was gaining on him rapidly. He said later, "First thing I knew there was a pig racing beside me making it look as though I was standing still." That animal possibly had no desire to do any attacking, despite many tales of the peccary's pugnacity. He had probably been confused as to our exact position, but all at once his weak little eyes suddenly noted the racing forester beside him, and so he veered off the trail, hit a stump, and somersaulted into the forest. That scene, tense at first, ended with a five-minute interval of laughter, after which we resumed the business of quinine hunting—minus pork.

The meat problem was often a real one. Because of the difficulty in securing carriers, we were always limited in our ability to carry much tinned material. We had to fend for ourselves, as well as for our men, who seldom brought along more than the most meager rations. A shotgun was essential and supplied us with what are called *gallinas*, or *pavos del monte*—various types of abundant wildfowl elsewhere called curassows and guans and belonging to the family *Cracidae*. Nor were *tunkis* and toucans exempt from the cooking pot. These lovely creatures usually proved far more tender than the tough domestic fowl of the Andes. Red meat was not as easy to obtain, and one would have needed a full-time hunter to search out game.

A big commotion among our carriers one evening, while encamping on a beach along the Tambo-



▲ PERUVIAN MULE TRAILS are often hewn out of solid rock and traverse territory impassable to all other types of travel. Cliffs are numerous, and many a mule has fallen thousands of feet to its death

pata, advised us that something was up. In a canebreak the Indians had surprised a Giant Armadillo and were chasing it as best they could through the thick underbrush, all the while pleading for a gun. At length they caught hold of the animal by its strong tail, and this was a signal for the armadillo to bury itself. So strong was it that it all but pulled the men along with it, to say nothing of throwing great quantities of earth in their eyes as it excavated a hole. Machetes were of no value against its strong armor, and only a close shotgun charge finally was able to pierce its plates. The meat was beautifully

tender and provided us with thick, juicy steaks, while its skin became a prized possession of one of the Indians.

On all our survey trips, samples of bark from different species of cinchona were taken, from which analyses and estimates could be made. Local names for these species were also recorded, for naturally the natives exploiting the bark were unfamiliar with the technical names of plants. In Peru and Bolivia, all types of cinchona are called *cas-carilla*, and from this word the Indian bark cutter receives the appellation *cascarillero* (or *quinero*). In Ecuador and Colombia, the name

*Continued on page 41*





◀ BROKEN REMAINS of a once verdant forest, these sandstone casts are the haunting mementos of large trees, some with eighteen-inch trunks

➤ THE RELATIONSHIP of early Indian remains indicates that the trees of sand were probably formed just prior to the time of Columbus

▼ STANDING like stalagmites, the naked trunks of tree trunks have survived centuries of wind and drought. The jackets of sand were formed by the chemical action of lime dissolved in rain water

# TREES of Sand

You might think that these utterly fantastic stumps would stump the experts, but there is enough evidence upon which to base a plausible theory of their origin and even their age

By LEWIS W. WALKER

*All photographs by the author*



GHOST TREES, curious mementos of an ancient forest, can be seen on the desolate, wind-swept islands of San Nicolas and to a lesser extent on San Miguel, two small bits of desert surrounded by the Pacific Ocean off the coast of Southern California. The odd shapes and sandy texture of these trees compel even the most unimpressible tourist to stop to examine them and wonder how they were formed.

Several theories have been suggested in an endeavor to unveil the mystery of their origin and to explain why the vegetation of only

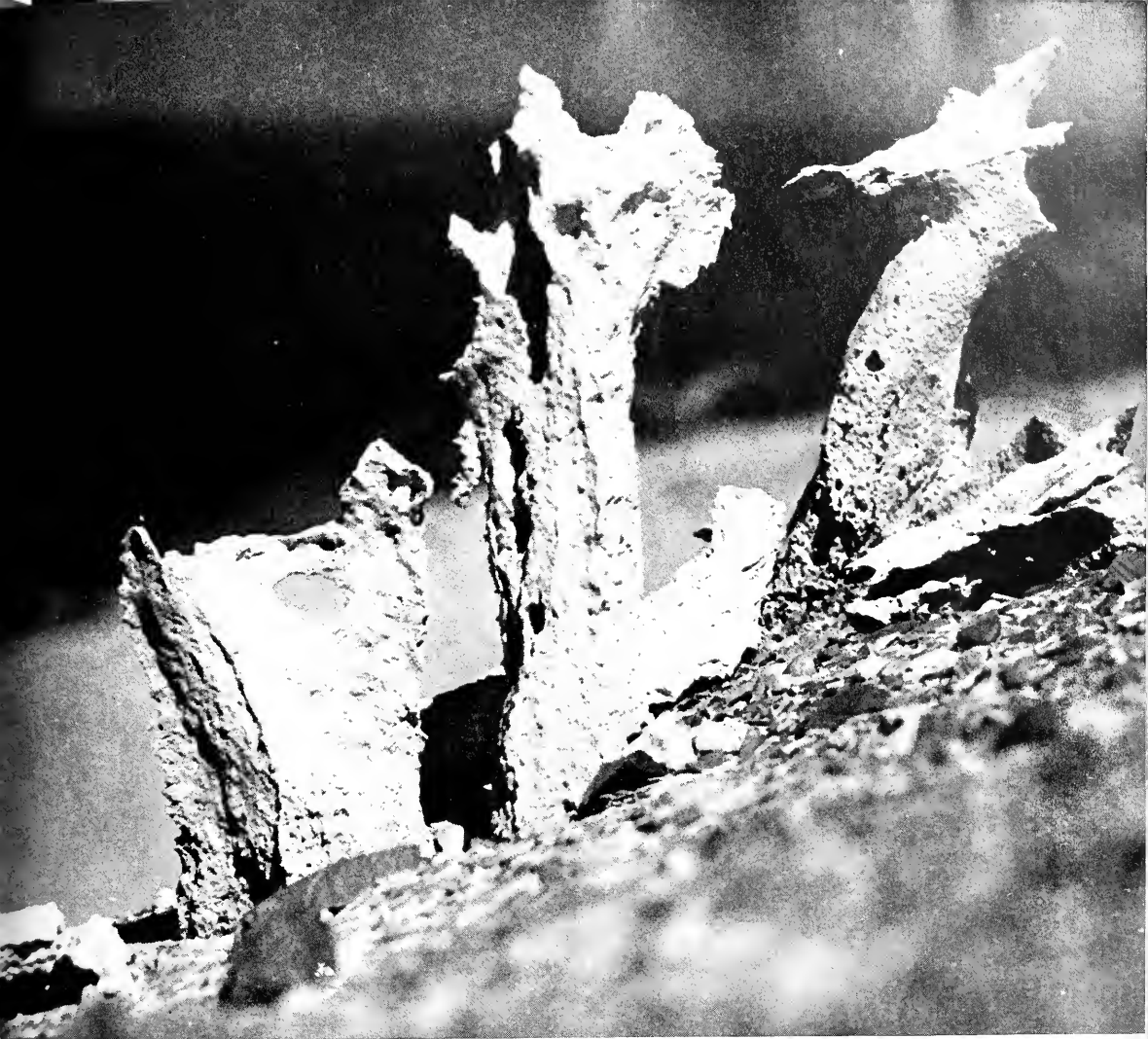
San Nicolas and near-by San Miguel were preserved in this way until the present century. Other islands in the same climatic zone and with almost the same type of soil are strangely barren of similar sandstone casts.

Factually we know that real trees once grew on these islands, that they died and were eventually covered by wind-blown sand. After their burial, the rotting trunks absorbed water containing an abundance of lime and other chemicals which not only impregnated the wood but also the adjacent soil. As the moisture evaporated, the chemi-

cals hardened and formed into hollow casings.

Now, hundreds of years later, the winds have uncovered these strange tubes and have left them standing like stalagmites. But the wind that brought them to light is also sandblasting them into oblivion. Trees that must have been forest giants with eighteen-inch trunks are now short and stubby—victims of an unceasing, relentless attack by the weather.

San Nicolas, wartime site of an air strip and radio station, is now deserted except for a species of dwarf fox, mice, and several hardy



birds. But at least three times in the past, according to investigations by Malcolm J. Rogers, the island was populated by Indians who eked out a living from marine mollusks and fishes. The remains of shellfish, no longer available on the tidal rocks, are to be found at the camp sites of the ancient people, and Mr. Rogers believes that these species were probably eliminated by over-fishing. There is also strong evidence that the now barren island was once covered by a verdant forest.

In these cultural remains there is a clue to how these sandstone trees may have been formed, and

by correlating the evidence a calendar of sorts may be formulated. First, before the time of Columbus, these coastal islands, now arid, had sufficient rain to support an abundant growth of trees and shrubs. Then came the drought. Wind-swept sand buried the vegetation. But in time changing conditions brought another luxuriant growth, this time in the form of low bushes which carpeted the ground.

Land snails thrived, living on the vegetation and increasing to such an extent that I wonder if they were not mainly responsible for denuding the islands of plant life. At the present time, their life-

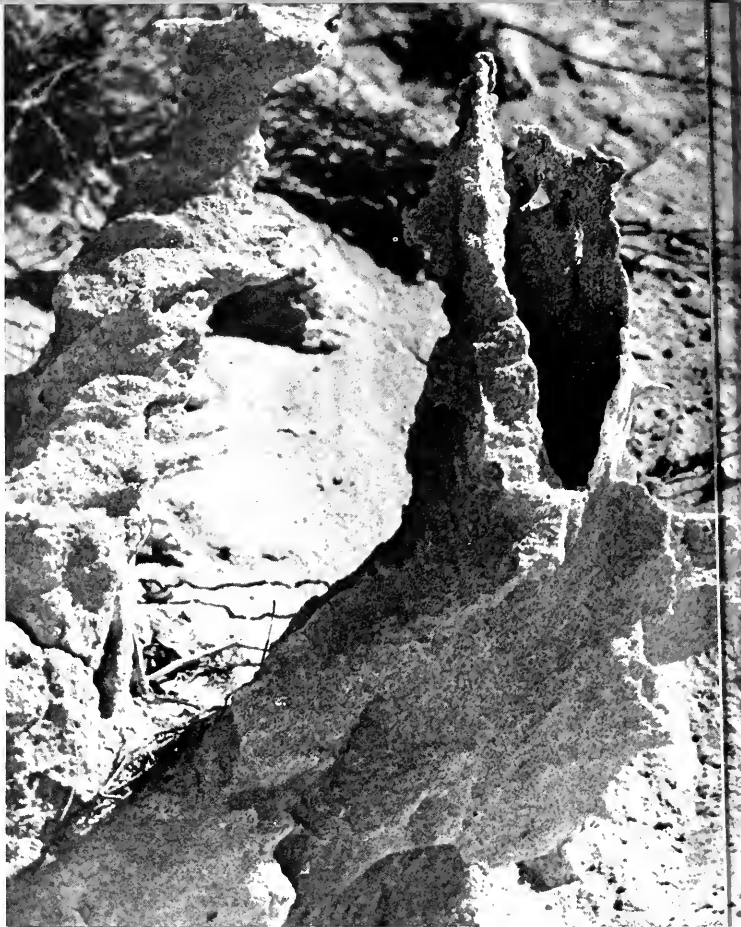
less, weather-beaten shells literally cover the ground, a condition not to be seen on other near-by islands, where the sandstone trees do not exist. Great numbers of these tiny mollusks died, perhaps suddenly, perhaps over a long period of time. Rains disintegrated their shells and carried the resultant lime in solution to the hidden forests beneath the surface. In this way, in theory at least, countless particles of sand were cemented together to form the tree-casts that are now being exposed and destroyed.

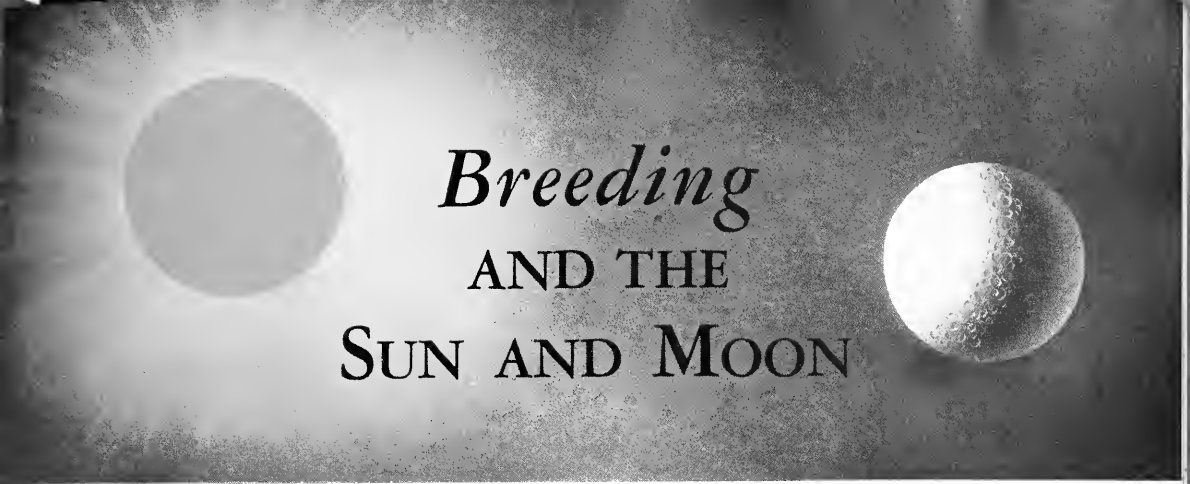
Without the three stages of Indian culture on San Nicolas, any attempt to date the trees would be

pure guesswork. However, the earliest people left tools of the crudest design, made simply of what the island offered, shell and bone. The time of occupation by the second people can be determined by their use of objects comparable to those of mainland Indians of the same period, which dates them at about the fourteenth or fifteenth century. Next came the Shoshone tribe, which was later conquered by the Spaniards. The trees grew *upon* the debris of the first island people but *under* the campgrounds of the second. Thus, through the relationship of the early Indian remains, a partial calendar can be deduced for these trees of sand. It indicates that they were formed just prior to the time of Columbus.

► LIKE A DOG guarding his charge, this crooked remnant tries to hold its ground against the relentless fury of island winds

▼ A DISTORTED SKELETON of a stump throws eerie shadows on a blanket of barren wasteland





# Breeding AND THE SUN AND MOON

The factor of light in the facts of life

By N. J. BERRILL

*Department of Zoology, McGill University*

THE breeding season and the corresponding habits of animals and plants have fascinated mankind for longer than recorded history, for human life has always been closely mingled with events in the world of nature. From ancient time men have been greatly concerned with the success of their crops, the abundance of animals to hunt, and with their own productivity. As their concern deepened they looked for the forces controlling fertility and made gods or religious rites of anything they thought responsible. So came the corn spirit, who had to be slain at harvest time to replenish the soil. Often a human victim, crowned as the corn king died a violent death in the character of the god.

Sunshine obviously influenced the earth's fertility and many savage races have employed charms for making sunshine. It is no wonder that primitive man in the cold and clondy climate of northern Europe did the same. It is no accident that the dates of the two most important festivals coincide with the summer and winter solstices. The midwinter celebration of Christmas was instituted by the church to supersede an old heathen festival of the birth of the sun, which was thought to be born again on the shortest day of each year and to grow until reaching full maturity at midsummer. The yule log was originally meant

to help the weakening winter sun rekindle its expiring light.

From worship of the sun sprang religious ceremonies involving fire. In the Vosges Mountains people believe that midsummer fires help to preserve the fruits of the earth and ensure good crops, while many European peasants believe corn will grow well as far as the blaze of a bonfire is visible. There is an Irish custom of driving barren cattle through the midsummer fires; and a girl who jumps three times over the bonfire will soon marry and have many children. The mythical "fern seed" of Bohemia is supposed to bloom like fire on Midsummer Eve, and whoever has it will find a vein of gold or treasures shining with a bluish flame. The "fern seed" is supposed to come from the sun's fire at its two turning points in summer and winter, and a hunter is said to have caught some by shooting at the sun on Midsummer Day at noon.

The old myths and legends of more primitive people are often looked upon as foolish imaginings, but when the subject is one of vital concern, it is apt to have a core of truth, no matter how much of the supernatural has gathered around it. So in the present century we have come to recognize the close control the sun actually has not only over

the growth of vegetation but its actual flowering. The warming temperatures of spring and summer force the growth of plants of all kinds, but the flowering is determined by the length of day. It is not a question of needing light for the green photosynthesis of plant substance but a much more subtle influence. According to their reactions, plants are grouped into "short day" plants, which flower only when day-length is short and change to vegetative growth during the long summer days; "long day" plants, which will only flower after the days have lengthened; and a group which is independent of the length of day. This relationship is rapidly being exploited by horticulturists and others, and under the controlled lighting conditions of greenhouses both the shape of a plant and the time of its blooming can be closely governed.

However important it may be, the reaction of plants to light is less spectacular than that of many animals. Animals, with their many varieties of eyes, respond to light not only from the sun but from the moon and even to the unearthly "starlight" of many living animals themselves.

In the poultry world, artificial light has been used to increase egg production for over a century. Lengthening of the daylight period in autumn has this effect. In wild birds, on the other hand, the dura-

tion of the laying period cannot be altered, but the laying season may be shifted readily from spring to autumn or to the middle of winter. In Japan, the use of artificial light to stimulate the reproductive organs of birds has been in use from fairly ancient times and is known as the practice of *Yogai*. In this way, pet birds are exposed to artificial light for three or four hours after sunset toward the close of the year in order to bring them into singing condition in January instead of in the spring. It was an old custom in Holland to use a similar method for catching song birds in autumn. Live decoys were placed in darkness in June and exposed to light again in September, so that they would be in full song during the autumn and attract the wild birds.

It was realized that daylight might be a factor in inducing the annual migrations of birds as early as the days of the Swedish poet Runeberg, in the 1870's. But it was another half century before two ideas were brought together to give a more detailed explanation,

namely that migrations are the result of developmental changes in the sexual organs and that light influences breeding. Even from the time of Pliny the extreme regularity with which birds migrate north had been noted, and temperature fluctuations were too variable to be held responsible. Observations of many migrating species now show that lengthening days bring the reproductive organs to full development, and this maturity itself gives the urge to migrate and sing. The mechanism involved is the eye, through which light enters and by nerve connection stimulates the pituitary gland. This is the master gland of the body, and too much or too little secretion in childhood produces giants or dwarfs. It also stimulates the growth of the reproductive organs, and so the light from the sun finally gains control of the sexual cycle. A similar chain reaction of sunlight, eye, pituitary gland, reproductive gland, and breeding season also holds for many of the mammals, one of the best known examples being the ferret. Experiments with the brook

trout indicate that its breeding season may be determined in the same way.

For all the primary importance of the sun to the welfare of human beings and animals and plants, the influence of the moon, where it is apparent at all, appears more mysterious and spectacular. It is no coincidence that the Easter and Harvest festivals are held everywhere at the full moon of the spring and autumn equinox. The moon's influence is most obvious on the oceans. It does not in itself make the tides, but it is responsible for the big differences between the neap tides occurring at the half moon and the spring tides of the full and new moon. Sea animals react to the tides and to the light of the moon and the sun in various ways. Perhaps the most famous are the palolo worm of the Pacific Islands and the grunion fish of the California coast.

The palalo, a small marine worm living in the tropical seas near Samoa, is a reliable sea calendar. All year it lives in holes and crevices among rocks and coral growth on the sea floor. But every year, true to the day, the worms come to the surface of the sea in vast swarms for their wedding dance. This generally occurs at dawn for just two days in October and two in November. They come the day before the first quarter of



AMNH photos

SHORTER DAYS cause some animals to change from a darker to a lighter coat, as in the case of the weasel, or ermine, shown here. Thus their protective coloration is only indirectly related to the approach of colder weather; the seasonal sunlight cycle controls both







▲ THE GRUNION is a smelt about six or seven inches long. It is relished by throngs of Californians, who park their cars bumper to bumper along the beaches to catch them

the moon, but they are most numerous on the second day, when the surface of the ocean appears covered with them. Actually only a part of the worm joins in the spawning swarm—the hind part, which swells with the sexual cells and becomes specially modified for swimming. On the morning of the great day each worm creeps backwards out of its burrow, and when the sexual half is protruded it breaks off and wriggles to the surface. The head end of the worm crawls back into its hole, where it grows a new hind region. The swimming sexual parts are several inches long, the males being light brown and the females indigo and green. At the time of spawning the whole sea around is discolored by the millions of floating eggs. The Samoan natives wait for the spawning period and relish the worms as food. They catch them in special baskets and prize them so greatly that native chiefs send them as presents to people living inland. The worms are cooked either in breadfruit leaves or without garnishment and are said to resemble spinach and to taste somewhat like fresh roe.

It has been the custom of island natives from ancient times to watch for these worms. The natives of Fiji, who call them "Mbalolo," have come to refer to the October and November swarming periods as *Mbalolo lailai* ("little") and *Mbalolo levu* ("large"), the November swarms being the larger.

The approach of the season is first noted by the appearance of the scarlet flowers of the *Aloalo*. The natives next watch for the flowering of the *seasea* and then look for the moon to be just on the horizon at dawn. And on the tenth morning the palolo worms appear. In the Savaii Island the coming of the

palolo is heralded three days in advance by the appearance of the *malis*, or land crabs, which march down from the mountains to the sea in swarms to breed in the ocean, a migration likewise related to the moon and as mysterious.

There are other palolo worms that swarm at different times of the year, but their wedding dance is just as closely correlated with the moon. In the case of the Japanese *Bachi*, it is the front end that breaks off and swarms just after the new and the full moon of October and November. Fishermen catch them by attracting them with lights. Around Fort Jefferson on the Tortugas, in the Gulf of Mexico, an Atlantic species generally appears within three days of the moon's last quarter in June and July. Two hours before sunrise the sexual portions rise to the surface; and when the sun strikes the water, they burst and scatter the eggs. The dying bodies sink down again into the mouths of the eagerly awaiting



Photos by  
E. C. LaRond

▲ ON the second, third, and fourth nights after full moon from March to June, myriads of grunion swim to California beaches to spawn. An hour earlier on the same tide, the eggs would probably be washed out and destroyed

fish. It might be thought that the spawning periods were determined by the state of the tides, but experiments have disproved this, and there is little doubt that the light of the moon, however it may act, is directly responsible.

Just as spectacular are the habits of the grunion, a smelt about six inches long, abundant off the coast of California. The spawning periods are holiday times for tremendous numbers of southern Californians. Cars are parked bumper to bumper along the coast highways for many miles, and the moon and thousands of beach fires light the scene. The fish are caught with everything available, from hats to bare hands, and are roasted over the fires, making excellent fare.

The extraordinary spawning habits of the grunion are about as perfectly timed as those of the palolo worm and just as mysterious. On the second, third, and fourth nights after the full moon (that is, on the highest spring tides in the

months of March, April, May, and June), the fish swim up the beach with the breaking waves to the highest point they can reach. They come in pairs, male and female. The female digs into the sand tail foremost and deposits her eggs some three inches below the surface. During the brief process the male arches around her and fertilizes the eggs. With the wash of the next wave, the fish slip back to the sea. Normally the eggs remain there, high and dry, until they are washed out of the sand by the next high spring tides, about ten days later. As soon as they are immersed again, the eggs hatch and the larvae swim down into the sea.

It is an astounding performance. If the eggs were laid during any other tide, or even an hour earlier on the same tide, they would probably be washed out and so destroyed. If they were laid at the dark of the moon, they would have to wait a month to be hatched, for the intervening tides of the full moon are never as high as those of the dark of the moon. But the two-week interval between the two sets of spring tides is the proper period for the gestation of the eggs and the period that the grunion usually manages to utilize. Incidentally, the succeeding lower tides actually bury the eggs deeper by piling up the sand. The fish mature and spawn at the end of the first year, and they spawn on each set of tides during the season.

Not only are worms and fish so conditioned by the moon, but the common European oyster, which changes its sex every few months, tends to "spat" in much greater numbers after the full and new moon than at other times. In Egyptian waters there is a spiny sea urchin that breeds only during the nights when the moon is full.

The moon stimulus is clearly not the same in all, for some marine animals respond to its presence and others to its absence. The fireworm of the Bermudas and West Indies is perhaps more understandable. This is an animal that not only breeds according to the phase of the moon but produces light of its own—a light that cannot be seen

well if either the sun or the moon is in the sky. In some ways it is like the palolo. The worms live in rocky crevices on the sea floor or in coral reefs and only come to the surface to breed. This they do every month throughout most of the year.

Each month for about a week, starting the second night after the moon is full, they leave their protected homes for their monthly honeymoon. At exactly half an hour after sunset on those nights, the spawning trip takes place. It only occurs in the dark. In the semitropics it is not dark until the sun has been set for at least half an hour. The full moon always rises as the sun sets but thereafter rises later every night. So for two days after the moon is full there is no period of real darkness between sunset and moonrise. After that, the dark period gets longer and longer, and it is with the beginning of this darkness every night that spawning occurs until the animals are finally exhausted.

The first fireworms to appear at the surface are the females. They arrive punctually and flash brilliantly with an over-all greenish-blue luminescent light that is visible in the water for more than 50 yards. A few moments later the males arrive, each with a pair of minute luminescent headlights, and they dart about like tiny stars caught in the blackness of the water. As soon as they see a female shining near by, the males in that region dive toward her. The first to reach her seizes her at the back of the neck with his jaws, and the two dive rapidly into the dark depths below, shedding eggs and sperm as they descend.

So between the moon and the sun, during the month or the year, the period of breeding among most kinds of living things is influenced directly or indirectly. And for that matter, man himself reacts emotionally to some of these things. The scientist will attribute it to social custom while the bride will say there is romance in the air; but who can deny that our lives are influenced by the lengthening days of spring, the full moon in June, and by starlight at almost any time?

# The JACKSNIPES' Wing-Song

A bird that sings  
without voice

By BEN EAST

THERE are few American outdoorsmen who are unfamiliar with the Wilson snipe. Although this long-billed shore bird has been on the closed list in recent autumns as a result of a marked decline in numbers, he was for a long time a favorite target of marsh gunners. Wherever shotgun addicts meet, he is known and discussed under the name of jacksnipe and admired for his twisting, zigzag flight and for the role he once played on the dun autumn marshlands. Birdmen know him, too.

A. C. Bent, in his *Life History of North American Shore Birds*, ventures the opinion that more snipe have been shot by hunters than any other of the clan, and to prove his point, he cites a kill of 69,000 by one gunner in Louisiana from 1867 to 1887.





Drawing by  
Dot Barlow

▲ FROM the "wide blue yonder" comes a soft, haunting cadence as the jacksnipe dives earthward toward his mate

Yet surprisingly few persons, either sportsmen or nature lovers, know that this erratic gamester utters one of the strangest, sweetest, and most eerie courtship songs of the bird world. Or perhaps it is hardly accurate to use the word "song," since the jacksnipe's music, made on the wing, is strictly instrumental.

Country school children know this queer wing-song well. Farmers hear it as they widen the brown strips of plowed land across their fields. All who are afield in marsh country in the warm, still days of late April and May have listened to it. But few can identify and name the maker of the high, far-off music.

The Wilson snipe has no power to sing. His vocal accomplishments are limited to the sharp "*scaip!*" of alarm he utters when he

rises out of the wet sedges ahead of the hunter in autumn and to a few notes of curiosity or protest heard on his nesting grounds. True song is beyond him.

As he moves north on the spring migration with his breeding season near at hand, he mounts high into the sky, far above the green-and-brown checkerboard of fields and woods and marshes. There he circles hour after hour, and every few seconds he interrupts his level circling to dip sharply down like a tiny, feathered dive bomber peeling off for an attack.

It is on this downward dive that he beats out the strange, pulsing notes known to birdmen as winnowing. Authorities did not at first agree as to how he did it. And it might seem impossible to find out, for the snipe sounds his courtship serenade

far aloft, in the lonely solitude of the "wide blue yonder," far from man's eyes. But ever since 1858 European scientists have been observing the common European snipe and experimenting to find the secret.

Manson-Bahr mounted the outer tail feathers on a cork attached to a string and rod, and by whirling this contrivance he made an almost perfect imitation of the music. Another experimenter showed that the tremolo effect was added by the vibration of the snipe's wings, which produced certain overtones modifying the music of the tail quills. The sound produced by the American subspecies is described as slightly different in timbre from that of the European snipes, but there is no doubt that the mechanism is the same in both.

The wing-song has, to humans on the ground far below, the quality of a far-off, soft whistle, broken into short syllables, pulsing with a haunting cadence. It floats earthward like the music of a spirit bird.

The first time you stand beside a strip of greening marsh on a windless May morning and listen to the distant "*hoo-hoo-hoo-hoo-hoo-hoo*" coming down from the sky at regular intervals, you are likely to be puzzled about the identity and the location of the musician. But if you search the heavens carefully, sooner or later you will locate the bird—no more than a black speck in the distance—wheeling in swift, wide circles. In a few seconds you will see him dip sharply, and then, after the space of time needed for the sound to travel down to you, you will hear again the sweet notes of the winnow.

At the end of the dip the snipe zooms back to his original altitude and resumes level flight once more, only to dip suddenly earthward again as if to gain the speed necessary for the production of his wing-song.

He keeps it up for hours at a time, doubtless to the delight and satisfaction of the shy hen snipe waiting somewhere in the boglands below. Even to human ears, spring has no bird note more unusual and mystic.





▲ OVER THE GROUND is spread a robe of ermine that hushes all the usual forest sounds. The trees in the foreground, dressed in regal attire, seem to stand in silent awe of the peaks of the White Mountains, California

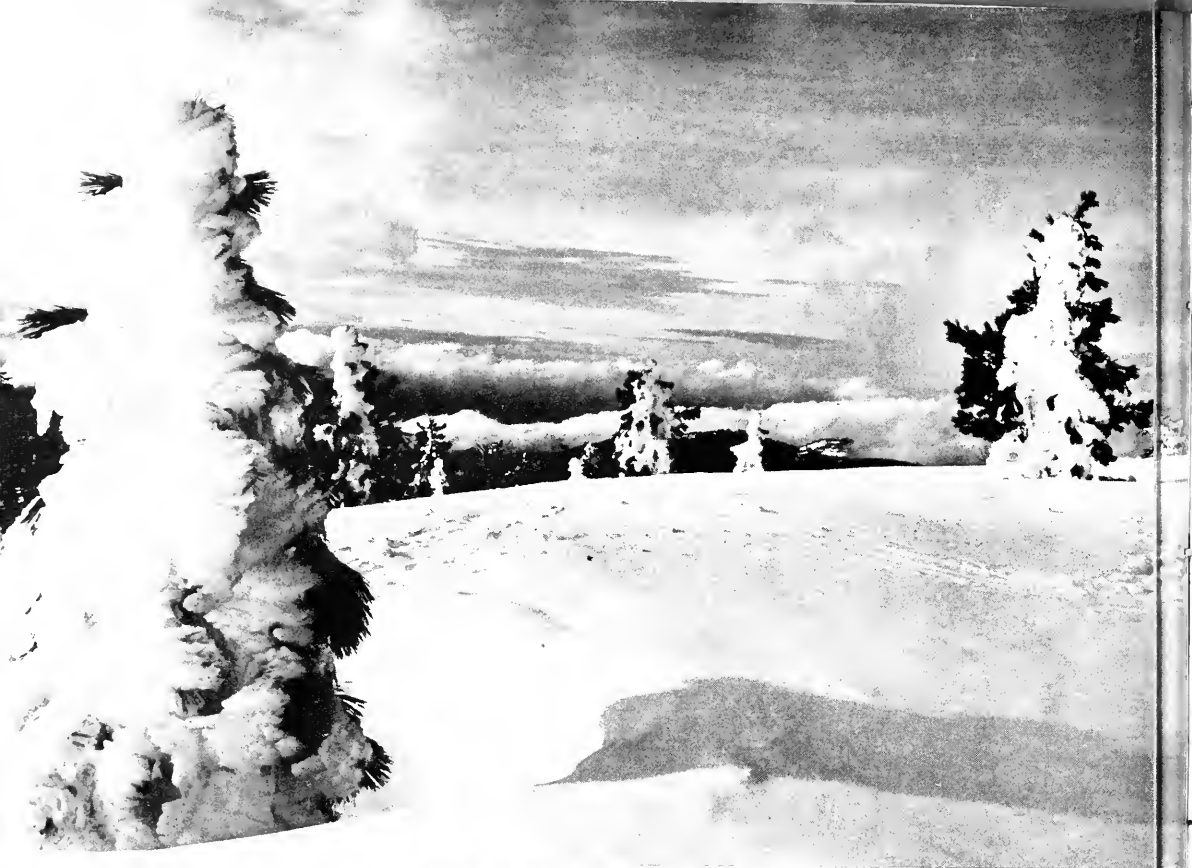
► SENTINEL ROCK. Lightly dusted with snow, the stalwart pinnacle stands guard over the Merced River. Yosemite, California

# WINTER *through the* CAMERA'S EYE

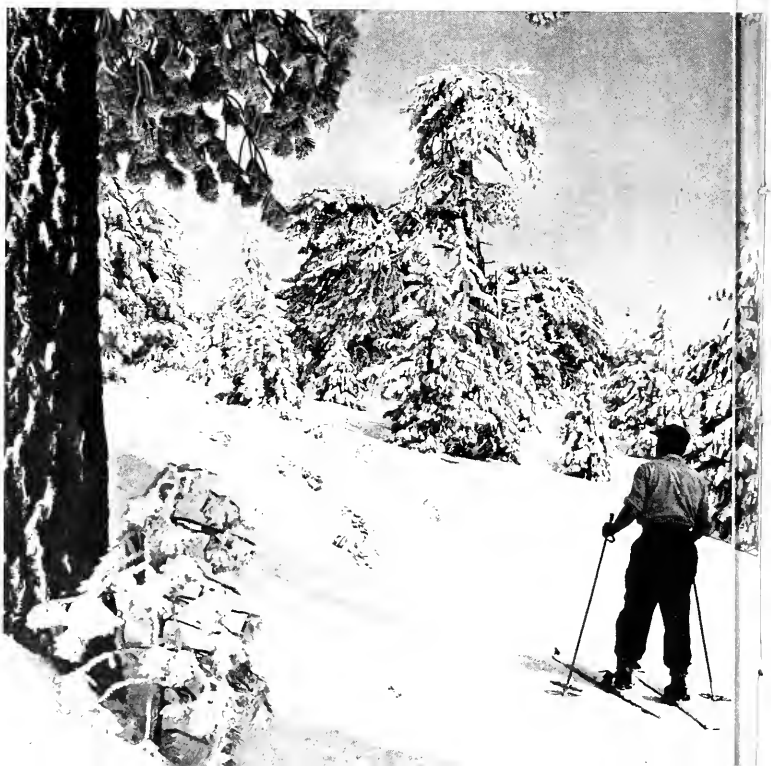
By JOSEF MUENCH

► CLOSED for the winter: a fire patrol lookout on Mt. Pinos. With trees locked in ice, the fire hazard is forgotten while the wind whips about the lonely, little cabin under leaden skies





▲ SNOW FIGURES. Winter with its snow and winds has used these Jeffrey pines as a foundation for grotesque figures populating a strange, white world. Clouds add a theatrical touch to the horizon and form a background that spells more of Jack Frost's work before the thaw



► WHEN everything that will hold snow is covered with it, and the air is crisp and clear, the hardy naturalist feels full zest for winter's wonderland. Frazier Mountain, California

# A "FOUR-LEGGED" Butterfly

By CHARLES D. MICHENER

*Associate Curator,  
Department of Insects and Spiders,  
The American Museum of Natural History*

*Photographs by RICHARD L. CASSELL*

ONE of the easiest ways of distinguishing an insect from a spider, daddy longlegs, centipede, or scorpion is by noting that it has six legs. A butterfly is, of course, an insect and therefore might be expected always to have six legs. However, these photographs, taken by Richard L. Cassell about 30 miles inland from Tokyo, illustrate something of which the layman may not be aware. They show a butterfly that seemingly has only two pairs of legs. No insects other than butterflies show this peculiarity.

This is one of the brush-footed butterflies, so-called because the two front legs are reduced to brush-like, clawless structures, as is clearly shown in the close-up. The brush-footed butterflies make up a large family known as the Nymphalidae, which includes some of the commonest and most conspicuous butterflies in America, such as the painted lady, the mourning cloak, the admirals, the checkerspot, and the fritillaries. Throughout this family the front legs of both sexes are so reduced as to be useless for walking, and sometimes they are quite inconspicuous.

Other families of butterflies also show this peculiarity to some extent. The monarchs, the satyrs, and the morphos, for instance, have reduced front legs in both sexes, while only those of the males are reduced in the blues, coppers, and hairstreaks.

Butterflies with front legs fully developed in both sexes include the swallowtails, whites, sulfurs, orange tips, and skippers.

A "FOUR-LEGGED" BUTTERFLY



▲ A BRUSH-FOOTED BUTTERFLY, photographed in southern Honshu, which has only two pairs of usable legs instead of three, as is the general rule among insects

▼ THE POINT OF A PENCIL here lifts one of the rudimentary front legs—a small, hairy appendage that can only be discovered through careful examination







By WILLIAM H. CARR  
 Photographs by MARVIN H. FROST

▲ AT HOME in a desert world of spines and needles. The softly furred White-throated Wood Rat is an attractive, gentle animal with highly interesting habits

IT is unfortunate that some of our most interesting, native American mammals are called "rats." When many of us think of this name, we immediately picture the decidedly unpleasant and often dangerous European invader, the Norway Rat, carrier of pestilence and destroyer of property in the homes and storehouses of man. Although we may grudgingly admire his intelligence, fortitude, and uncanny opportunism, we set our traps in the fervent hope that we can destroy him, for we regard him with extreme disfavor often born of fear.

Our North American species are far more independent and attractive than their imported cousins. They shun cities in favor of forests, plains, and deserts, seeking their livelihood from the land. The reason for the all-embracing name is, of course, apparent. Our rats *are* rats, members of a world-wide tribe, and must bear the stigma accordingly. Nevertheless, they deserve a far greater degree of respect and admiration than they usually receive.

The Western Hemisphere rats that most closely resemble the Eu-

ropean invaders in superficial appearance are the Wood Rats, distributed in one form or another throughout a large part of the United States and southward to middle America. They are more numerous in western regions, ranging northward to the Yukon. The naturalists Audubon and Bachman called attention to the attractiveness of these animals and advocated their domestication.

Wood Rats have large black eyes, rounded furred ears, clean soft hair, and long "whiskers." On examination they seem to be overgrown

# Home-Builder

Despite its name, the White-throated Wood Rat is one of the most entertaining creatures of the wild, and its skill in laying a "barbed wire entanglement" to protect itself and its young is truly amazing



▲ SOME WHITE-THROAT dwellings consist of seemingly haphazard piles of cholla cactus joints, built within the protective circle of prickly pear growths

white-footed mice, both in appearance and disposition, for they lack the furtive, aggressive, and obnoxious habits of the Norway Rat.

We have kept several of these local animals as pets and have investigated their homes and behavior indoors and out. Our acquaintance with them includes both eastern and western kinds—the Allegheny Wood Rat (*Neotoma pennsylvanica* Stone) and the White-throated Wood Rat (*Neotoma albigula albigula* Hartley). The Allegheny variety was for a time a resident of the Bear Mountain

Trailside Museums, near New York City. The animal was discovered in the vicinity of the Hudson River not far from the northern limit of its range in the eastern section of the country. We maintained him as a pet and as an exhibit for museum visitors. He proved a most tractable and cleanly creature, but because of his name, most people shunned him, thus missing an opportunity of becoming acquainted with a most interesting and locally uncommon animal. If the cage label had read "Wood Rabbit" instead of "Wood Rat," he would without a doubt

have received greater attention.

Duties connected with building and operating a public museum prevented us from spending much time with our Allegheny specimen. However, when we left the Hudson shores and journeyed to live in the desert region near Tucson, Arizona, our opportunities for acquaintance with the wood rat were limitless, for here the animal truly comes into its own. One might say they are practically our neighbors. On the near-by Santa Rita Experimental Range of the United States Forest Service, scientific investigation in 1940 revealed that there were some 200,000 wood rats in the 50,808 acres of the entire range. The survey was conducted by Dr. Charles T. Vorhies, of the University of Arizona, and Walter P. Taylor, then of the Biological Survey.

Observant travelers along desert roads often see mounds of debris piled beneath cactus plants, mesquite, or palo verde trees, or standing alone. They may be as high as five feet. These mounds, composed of cactus branches, sticks, and other similar material, are the homes of the white-throated wood rat. Like the houses of the beaver and the muskrat, the wood rat's dwelling is his castle, however unprepossessing it may appear and regardless of the fact that it is surrounded by sand rather than a moat of water. The desert resident must have protection from a host of enemies ranging from snakes and owls to coyotes, bobcats, and skunks. It must have a place to rear its helpless young and also a shelter from the intense, direct rays of the desert sun.

Unlike its immediate neighbors (the kangaroo rats, round-tailed ground squirrels, and pocket mice), the wood rat of the desert does not burrow to any appreciable extent, although it may dig open trenches beneath its mound of sticks. Therefore, its home must be made of available materials and erected on the hot desert surface. Thanks to nocturnal customs and to the adequate protection provided by its dwelling, the wood rat is quite successful in escaping daytime prowlers; but at night, enemies offer a constant threat whenever the ani-

mal is abroad in search of food or home-building materials.

When the white-throated wood rat selects the branches of the cholla cactus as construction material, as it frequently does, the result is a veritable fortress. The sharp spines of this murderous plant must discourage all but the toughest predators that might conceivably be tempted to enter or tear apart a wood rat's nest. The fact that the soft-footed wood rat is able to use this cactus as building timber is something of a minor miracle. Humans who take any liberties whatsoever with the cholla are bound to regret it and to spend considerable time removing the spines, which drive deep into the flesh upon the slightest contact.

Despite the excellence of the house as a protective device, we have seen evidences that our wood rats sometimes have their serious

troubles in daylight as well as in darkness. Once, while visiting the Saguaro Cactus National Monument near Tucson, we were surprised to see a full-grown wood rat running about in mid-afternoon. It appeared suddenly on the top of its nest, which was placed amid the branching trunks of a spreading mesquite tree. We did not wait long to discover the reason for the rat's unexpected appearance.

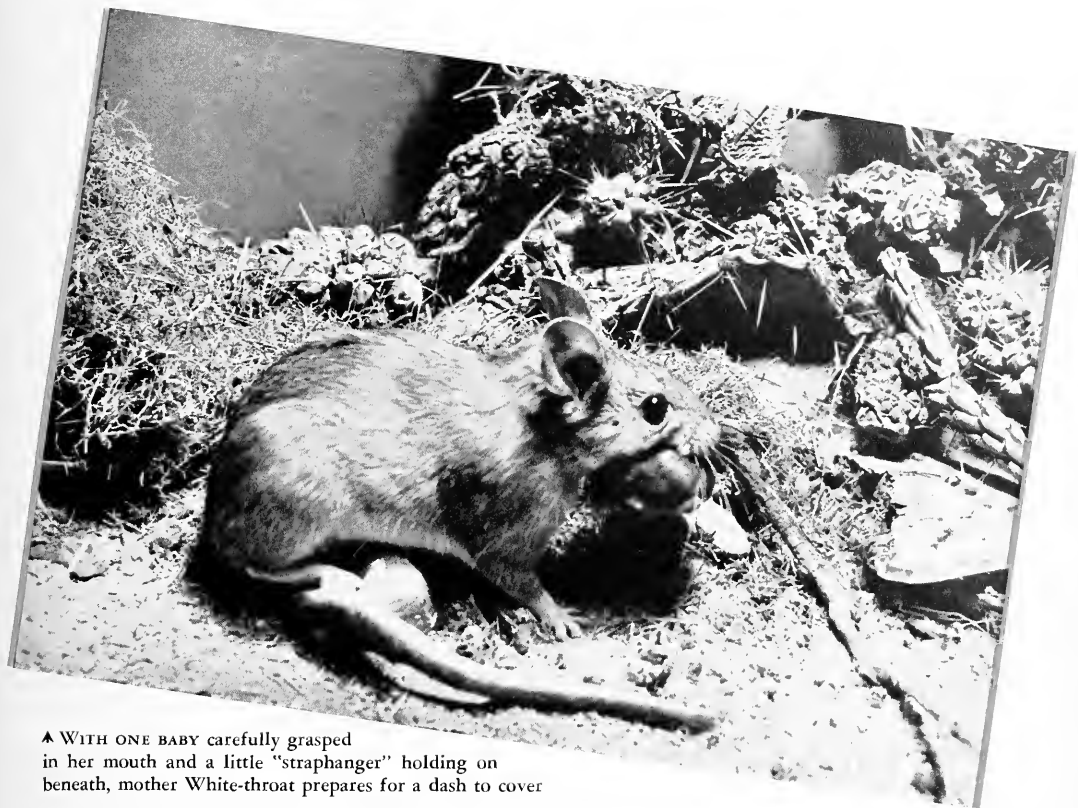
In a moment a long, sinewy, and swiftly traveling Red Racer, or Whip Snake, came rushing out of the white-throat's house and darted toward the alarmed and dispossessed resident. The rat then ran quickly up the tree, with the snake in hot pursuit. When the unhappy rodent, with long whiskers trembling, was almost touched by the snake's nose, it flew down the tree and popped into the nest again. The snake paused for a moment and

then followed but without the speed and intense interest it had formerly exhibited. At this point we became active, for we had a particular need of a whip snake for purposes of photography. We captured the reptile and thus removed from the scene at least one of the white-throat's enemies. Yes, the desert home builder has its alarms, and doubtless many a narrow escape from tooth, talon, or fang, in the course of its frequently harassed existence.

On one occasion we decided to obtain a wood rat and keep it for a time. We selected a large, promising mound and removed the roof of the house with more speed than ceremony, using a long-handled shovel for the purpose. The day was blazing hot. We wanted to study and photograph the occupant of this rustic home and if possible to tame him; and we were desirous

▼ ON THE LOOK-OUT: this large-eyed White-throat peers about while one of her infants maintains a firm grip





▲ WITH ONE BABY carefully grasped in her mouth and a little "straphanger" holding on beneath, mother White-throat prepares for a dash to cover

of returning to town as quickly as possible. As the dried cactus stems, branches, and other debris were tossed aside, we kept a sharp watch for the actual nest, wherein we confidently expected to find the animal. We knew from previous investigations that this nest would be composed of shredded cactus, grasses, or other soft material, that it would be round in shape and quite compact, and located somewhere near the center, close to the ground. Soon we came upon it; and when we opened it, we discovered not only an adult white-throat but two infants as well.

This mother was as faithful to her maternal instincts as any mammal we have ever encountered. While greatly alarmed by the catastrophic demolition of her home, and with her sides heaving in rapid breathing, she did not streak off across the desert to the nearest

clump of shrubs as so many other animals would have done. She simply would not leave her family. One of the little ones was attached to its mother's nipples, a well-known habit of these animals. During the dashing about of its parent, this young one never for a moment relinquished its grip.

When the mother was first revealed, she lay with her blind infants; but when the strong sunlight reached her, she left the nest and ran a few feet away, with the young one maintaining its hold. Then, without hesitation, she ran back to the other, momentarily deserted baby and grasped it firmly in her mouth. Thus, with one of her offspring clinging beneath and the other held well off the ground, the parent commenced to seek a means of escape, running this way and that as we sought to capture her. Once she dropped the one

from her mouth but quickly retrieved it. After several minutes, we had the family safely stored in a wooden box with a wire top. We put the box in the car and sped homeward.

A fine, cool, roomy cage awaited the trio. We installed several large prickly pear and cholla joints and carefully arranged the nest, which we had also secured. Upon her introduction to the cage, the mother immediately carried one of her young into the nest, while the other still hung on below. We left the animals with a small pan of water within reach.

That night soon after dark, the mother, minus her young, peered cautiously from the nest, then slowly emerged and explored the interior of the glass-fronted, wire-topped enclosure. She walked right through the water without drinking a drop. Her long tail, covered with



hair and quite unlike the naked appendage of the Norway Rat, was held off the ground as she stepped daintily about. After a time she sampled the prickly pear, eating a section about as large as a half dollar and one inch thick. We could hear the young ones squeaking within the nest. Soon she returned to them and all was quiet.

In about an hour she once more appeared. This time, in addition to surveying the cage very deliberately, she evidently was not satisfied with the exposed condition of her nest. She climbed upon it many times and moved the topmost covering slightly. Then she advanced to the cholla joint, closed her teeth gingerly on one of the sharp spines, and tugged at it until she had succeeded in placing the entire joint over the highest part of the globular nest. It was a laborious, painstaking job, and how she avoided being impaled by the adjoining spines was a mystery, for the joint tumbled about as she moved it.

We have seen a white-throated wood rat perched in the midst of a large, well-armed cholla plant. How the animal managed to climb the cactus without injuring itself is surely a remarkable thing. The white-throat will line the pathways leading to its house with rows of cholla joints, thus discouraging many a hungry predator, large or small. One such pathway was lined for a distance of eighteen feet and was so narrow that the builder must have found it necessary to walk or run as though on a tight rope in order to avoid severe difficulty when traveling to and from its well-constructed home.

The faithful parent lived in her cage for about ten days while we made photographs of her and her young. We observed her habits under the cramped and unnatural conditions and gained a lasting impression of a very remarkable little mammal. Though we placed our hands very close beside her, she never once attempted to bite, nor did she ever assume a threatening or belligerent attitude. At all times her young were her first consideration, and she cared for them as well

as she possibly could under the conditions she was forced to accept.

Eventually we decided to rebuild the white-throat's desert home and place her in it, nest, babies, and all. A number of children and adults had observed the wood rats in our home and were decidedly interested in the ultimate fate of the animals. We had preached "live and let live," and as one of our visitors expressed it, the patience, gentleness, and devotion shown by our temporary captive deserved some reward. We agreed.

So we returned to the spot and gathered the scattered cholla and sticks, heaping a mound and securing additional building supplies from a near-by, abandoned nest. The original builder had accomplished a far better job than we. Nevertheless, we completed the project and carefully placed the soft nest and its occupants within the rehabilitated dwelling. Then we added a few finishing touches, chopped off some fresh and particularly succulent prickly pear joints, and left them within easy reach.

The ability of wood rats to live in regions where there is absolutely no standing or running water during practically all the year has caused many people to marvel. One explanation is found in the succulent cactus and other plant food that supplies much moisture in a land where the temperature reaches 112 degrees or more in the shade and as much as 150 degrees in full sunlight; where the dry, highly evaporative desert winds sweep across the landscape, and all is still in the white heat of noon.

One also wonders how the fur-covered animal endures the heat. The loosely constructed home provides some measure of shelter from direct sun rays, but the interior of the house must be very warm indeed. Perhaps the grassy, fibrous nest within provides better insulation than the interwoven sticks and desiccated cactus joints above. One thing is certain, however, there can be little circulation of air within this small, compact structure. I do not know whether the wood rat

spends most of its inactive time within this hideaway beneath the main structure of the home.

At night the wood rat is anything but inactive. It is one of the busiest animals one could imagine, equaling if not surpassing the beaver in its tireless activity. Apparently, it never ceases to work on its house and adds materials to the structure constantly. The little animal is a great collector of this, that, and the other thing. It has earned the name "Pack Rat" through its propensity for picking up almost anything that may be moved by its own efforts and transported to its dwelling.

One deserted home we dismantled contained an amazing assortment of objects, including several ancient tobacco cans, the handle of a parachute rip cord, numerous tin-foil wrappers, an olive bottle, chicken bones, a small coiled spring, several magazine pages, tin cans, a wrist watch strap, and a badly burned-out tobacco pipe. It is not uncommon for persons who sleep peacefully in bedrolls to discover that various possessions have been removed from the camp site. Boxes of matches, tin plates, cutlery, cigarette packages, pocket knives, wrapped sandwiches, and even money—to mention a few items—will be mysteriously missing in the morning and often may be found on or within a near-by white-throat's nest.

Wood rats in mountain areas have long been famous, or infamous (depending upon one's viewpoint), for their behavior when invading remote miners' or hunters' cabins. Such things as watches and ammunition, cartridge by cartridge, have been taken away by the nocturnal explorers. One miner in northern New Mexico, with a perfectly straight face, told the writer that he had depended upon a pack rat to provide kindling for his fire each morning. When he moved into his cabin, he discovered that a wood rat had a nest in the stove. This nest was composed of small, dry sticks. Upon arising the next morning, the miner proceeded to drive the wood rat from the stove and then simply applied a match



▲ UPSIDE-DOWN or right side up positions seem to make slight difference at mealtime. Concern for the welfare of her offspring marked the mother's every move

to the "kindling." In this way he soon had a roaring fire and was able to prepare his breakfast.

Then the miner went off to work, taking care to leave the stove door open. The next night the pack rat proceeded once more to fill the stove box with small sticks. Thus again on the second morning there was sufficient kindling for a speedy and effortless fire.

"Why," said the miner, "that old

pack rat filled my stove, and I never had to gather a stick of kindling all the time I lived in that cabin! It's the first time one of those fellows ever did me any good!"

My face was straight too; otherwise I should have missed a good story.

The many and varied accomplishments of the wood rat need no imaginative embellishments. We feel that the desert would be a bar-

ren place without this intelligent, attractive, and decidedly worthwhile creature. On close acquaintance, its interesting and instructive ways are sure to arouse one's admiration. But more, the wood rat symbolizes the remarkable ability of some mammals to adjust to a harsh environment and to live wherever nourishment and shelter can possibly be secured, regardless of a severe climate.

# Bedlam Arms APARTMENTS

A visit to a colorful rookery in the Philippines, whose raucous inmates were as interesting a group of bird personalities as any tenement tree could shelter

By KEN STOTT, JR.

*Curator of Mammals and Publications,  
San Diego Zoo*

*Photographs by G. E. Kirkpatrick, at the San Diego Zoo*



▲ THE CATTLE EGRET wears a buff-colored headdress that turns almost to tawny gold at the height of the breeding season. This and the buff-colored mantle down the back later match the satiny white of the body

OUR port wing dipped low over the Zamboanga Peninsula, and through the dusty windows of the plane we watched interminable rice paddy and swamp-land rush past. Here and there small open patches of standing water captured and reflected the rays of a near-equatorial sun, as would the fragments of a shattered mirror.

As we flew overhead, black and shining water buffaloes, or carabaos, plunged through the swamp grasses, and above them, like flurries of snowflakes, swarmed terrified flocks of small white herons. This was our introduction in the wild to those constant companions of water buffalo herds—the cattle egrets.

We had known them previously in the San Diego Zoo flight cage, where they lived and reared their young. In Martin Johnson's films we had watched them as they perched on the backs of buffaloes or elephants along sluggish African rivers. Now, here in the southern Philippines, we saw them for the first time unconfined by the limits of cage or motion picture screen.

We arrived in Zamboanga in early August, 1945, and in the months that followed we were to become well acquainted with these birds. They were constantly in evidence on our wanderings through the marshes, often serving to warn us that a herd of half-wild carabaos foraged somewhere near by. Occasionally cattle egrets even came into our backyard, attracted by the lone carabao cow that belonged to our Filipino neighbor.

During our first few days in Zamboanga, we caught only momentary glimpses of the birds as they flew over the city on their way from one rice paddy to another. But as soon as our laboratory equipment had been installed, we made our first trip into the marshes over which we had flown a few days before.

Primarily our purpose was to determine whether or not snails bearing liver flukes were present in the local swamps, but we hoped also to establish at least a nodding ac-

quaintance with some of the vertebrate denizens of the area.

From the elevated roadbed, the marshes about us appeared tame enough, but once we began to penetrate them we found the going rough. Marsh vegetation growing high above the level of our heads formed a solid wall of green on every side. The mud sucked and gurgled at our feet. Rustlings in the reeds close by and an occasional unrecognizable squawk gave us ample cause to wonder what beings shared with us this murky labyrinth.

Sometimes we were fortunate enough to see the creatures that made these sounds, and never did they warrant the alarm they had caused. Once a white-breasted water cock scuttled into the vegetation ahead of us, and later we flushed a pair of woolly-necked storks. Rails of various species chattered continually.

Soon the only emotion these minor rustlings and vocalizings aroused in us was that of curiosity, not fear. Such confidence was short-lived, however. No sooner had we begun to feel there was nothing near that could harm us than a violent thrashing a few feet away sent chills racing up and down our backs. No creature we had seen thus far could possibly produce sounds of such proportions.

Suddenly the sky was filled with cattle egrets, and from the mad



▲ A SHELL-PINK BILL and olive legs complete the delicate color scheme

scrambling and stomping ahead, we concluded that we had surprised a heard of grazing carabaos. The herons overhead careened in wide circles, sweeping low to get a better look at the invaders. We, in turn, could clearly see their white bodies, the buff coloration on their heads and backs, their shell-pink bills, and their olive-scaled legs.

Soon convinced that we meant no harm, they dropped out of sight beyond the reeds a short distance away, and we began to move toward the spot as quietly as possible. By craning our necks and peering through openings in the high grass, we could see them perched on the broad, wet backs of the water buffaloes. The birds, well aware of our presence, at first stood motionless, examining us intently with snapping eyes. But once accustomed to our proximity, they resumed the activities we had interrupted.

Some individuals pecked at the backs of their appreciative hosts, removing what were, no doubt, annoying parasites. Others flew to the ground and greedily devoured grasshoppers and other large insects. Their diet is composed almost entirely of insects and ticks.

At this point, we changed our course, being perfectly willing to leave the field to the carabaos. We continued through the rushes for some distance until at length we

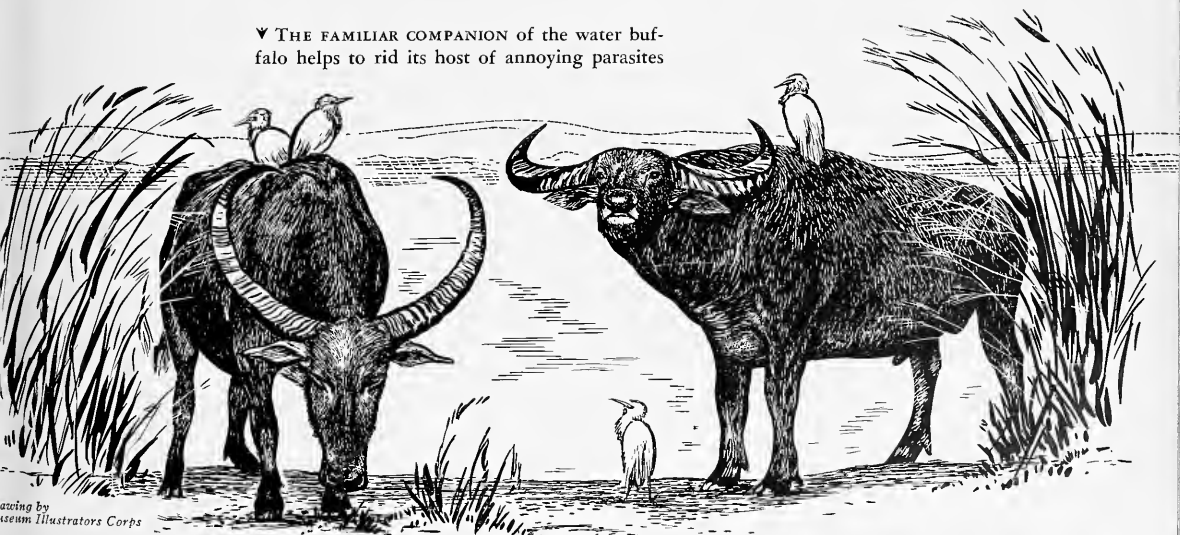
emerged to find ourselves on the edge of a swampy forest, reminiscent of those of the Louisiana bayous. Cockatoos, gleaming white and crimson vented, shrieked in the treetops, and green-winged ground pigeons maneuvered skillfully on fast-beating wings through the underbrush.

Here we had our first unobstructed and unhurried views of cattle egrets. A group of small trees before us was literally covered with them. In fact, these trees might best be described as communal nurseries, for their branches sagged beneath the weight of heron nests. Each of six or seven trees supported from fifteen to twenty nests. Side by side two species of heron, cattle egrets, and the bulkier rufous night herons were rearing their gnomelike young. The nests had been constructed so close together that the occupant of one could, and frequently did, reach into an adjacent nest to remove the eggs of an unsuspecting neighbor.

All adult cattle egrets were in full breeding plumage. The buff of their heads, necks, and backs approached tawny-gold in color and contrasted with the satiny-white of the remainder of their plumage. Further contrast was provided by the equally numerous night herons, dusty-red with steel-blue wings.

Social relationships among the

▼ THE FAMILIAR COMPANION of the water buffalo helps to rid its host of annoying parasites



drawing by  
useum Illustrators Corps

birds were anything but harmonious. Verbal bickering was incessant and often culminated in furious battles in which swift, darting jabs were exchanged by the contestants. Such disagreements did not occur only between different species; a cattle egret was just as inclined to quarrel with one of its kindred as with a night heron. The turbulent atmosphere of the rookery caused us to dub it "Bedlam Arms Apartments."

During the ensuing months we

revisited the colony regularly. Cattle egret babies that we had first seen as downy balls of fluff became sleek and graceful, and night heron youngsters exchanged their swaddling clothes for the streaked and spotted plumage of adolescence. By November, even adult cattle egrets had undergone a change of garb. Their golden caps and mantles had vanished, and their plumage was now snow-white throughout.

In winter months the rookery no longer served as a nursery, but

it was still frequented by cattle egrets. Each evening, after a day of following the carabao herds through the marshes, the egrets would return to what now constituted their roosting place. As the last rays of the sun washed the tree-tops, they would shimmer down, lining each twisted branch. Once again the harsh sounds of heron conversation would fill the forest to offer indisputable evidence that the Bedlam Arms Apartments had been well named.



◀ LIKE AN ANIMATED INTERROGATION POINT:  
a cattle egret preening

▼ THE BIRD is about nineteen inches long. At its "mass meetings" in the swampy forest, it makes more noise than many larger birds



**B**OUNCING along the narrow, dirt road leading easterly toward Wupatki from U. S. Highway 89, we saw nothing remotely suggesting the excitement of a land rush. There were no settlers scurrying madly, no cities being born—only rolling mesa, a sparse copse of ragged junipers, occasional tufts of bunch grass, and a few distant outcroppings of red sandstone.

No wonder the lack of activity; we had arrived on the scene too late to participate in Arizona's great land boom—not merely a few days late but approximately 900 years.

Rolling back the intervening centuries, we tried to visualize the event. There were no newspapers, of course, but even in the eleventh century, word got around, and the people were not slow in taking notice of an agricultural plum. Over the high Coconino plateaus and across the Painted Desert the news swept, down into the choya-grown flats, where impoverished farmers sat watching their corn leaves yellowing and their half-filled bean pods shriveling from lack of rain.

Fertile soil, free land!—magic words, these, words whose power is universal and timeless. Primitive man packed his chattels, his cooking vessels and baskets and pottery, his digging sticks and stone hoes and precious seed, and set forth for this rumored Land of Promise.

Some of the Hohokam farmers of the south left their irrigated fields, where over-long tillage had stripped the soil of fertility. The Pueblo dry farmers came down from the northeast. From the southeast arrived the Mogollon groups; from the west came a delegation of slow, backward men, who had little knowledge of agriculture but vast knowledge of hunger. To that central plateau between the snow-capped San Francisco peaks and the Little Colorado River, these eleventh century immigrants brought their babel of diverse tongues, their tribal games and customs, their differing modes of worship and burial and pottery manufacture, their widely divergent views on politics and morals.

Surmounting their individual idiosyncrasies and foibles, and labor-

# ARIZONA'S *First* *Land Rush*

How a volcanic eruption brought many diverse Indians together to produce a thriving community nine centuries ago: the story of Wupatki National Monument

By NELL MURBARGER

ing together for the common good, the beleaguered colonists soon found themselves entering an era of prosperity the like of which they had never known. Cities rose upon the hilltops. Fortress apartment houses two and three stories high were erected of stone masonry. Fields of corn and beans and squash grew green and productive. Granaries filled to overflowing.

Within a few years, a hitherto uninhabited wilderness was transformed into one of the country's most densely populated areas. As time went on, the sharply-etched lines of tribal practices began to disappear. Gradually a unique blend of life and customs developed in this Coconino county melting pot—the only place in the Southwest where archaeologists have found all four of these pre-Columbian cultural groups.

But whether the principals be red man or white, history unfortunately follows an all-too-familiar pattern.

When 100 or 150 years had passed, old men of the colony no-

ticed that the fields were not so productive as they had once been. The ears of corn were shorter at maturity, the bean pods no longer well filled. It was the old, old story of drought cycles and over-cultivation—valuable topsoil lost forever to the forces of erosion, broad fields laid bare to the ravaging clutches of the wind. It was a story as old as Nineveh and as new as the Dust Bowl.

Effort was made to check these forces. But the long rows of stones that had been placed along the contours of the hills to hold and spread the moisture that fell as rain were not enough. The wind, as though driven by malicious spirits, swept the fields bare, carrying the topsoil across the plateau, piling it elsewhere in deep, useless drifts, and leaving the farm lands unable to hold the rain.

By the middle of the thirteenth century, the desert had reclaimed its own. One by one the disillusioned colonists drifted away, some to Verde Valley, others to Montezuma Castle, Tuzigoot, Hopiland.





*George A. Grant photo, courtesy National Park Service*

Behind them they left their stone cities, their great communal dwellings, their dreams of prosperity. When the first Spanish explorers entered the American Southwest some 300 years later, they found the once-populous pueblos falling into ruin, their only occupants the creeping things of the desert and the ubiquitous wind.

Four centuries have passed since the first Europeans viewed these skeletal remains of a decayed civilization. Yet, strangely, no great change has taken place on the plateau. Today, in Wupatki National Monument, even the casual student of archaeology can read the well-preserved story of that eleventh-century land rush.

How was it, one might ask, that this desirable farm land had been overlooked so long, in a region where every tillable acre had been cultivated for untold centuries? The answer lies in the black heart of Sunset Crater, a few miles to the south.

Before about A.D. 1000, geologists affirm, there was slight inducement for a man to settle on that arid wasteland between the San Francisco peaks and the Painted Desert. While a few Indian families clustered at the base of the peaks where snows of winter made farming feasible, the plateau proper was a region of scant rainfall and rapid evaporation, with long periods of unbroken drought.

About A.D. 1066, a series of sharp tremors shook the land, causing the

◀ **SUNSET CRATER**, a few miles south of Wupatki National Monument. Its eruption precipitated northern Arizona's greatest land rush about 900 years ago by laying a moisture-retaining blanket of volcanic ash and cinders over the land

▼ **PORTION** of a ten-room pueblo in Wupatki National Monument known as *Nalakihu*, which means "House Standing Alone." Five rooms were excavated by Hopi workmen under the Museum of Northern Arizona in 1933-34, and two were later restored



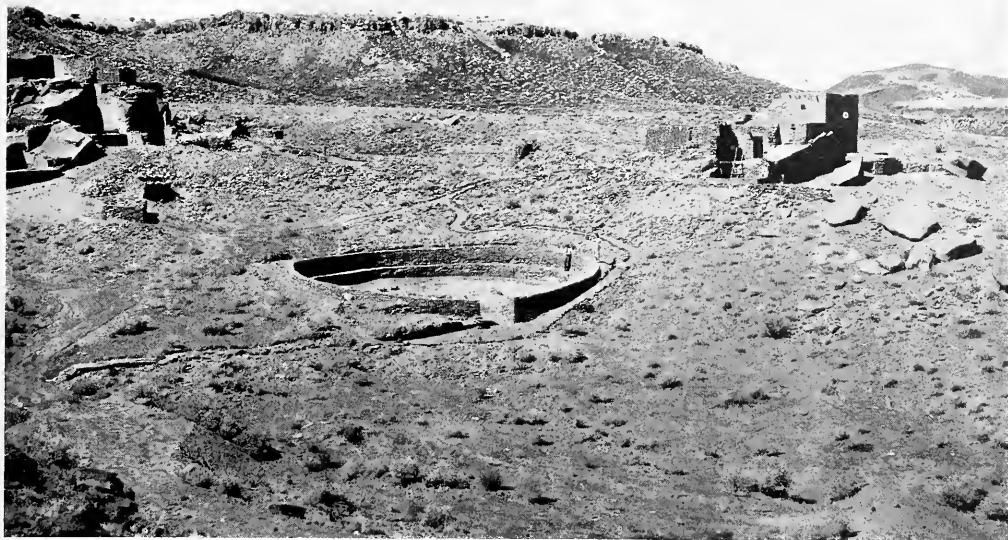
*Nell Murberger photo*

more prudent of the scattered inhabitants to flee in terror from their rude pit shelters, carrying with them such belongings as they might. The shocks ushered in a final burst of volcanic activity in a region where periodic disturbances had occurred during millions of years.

This final twitch of a dying tail was eventually manifested in the eruption of Sunset Crater. In comparison with the earlier cataclysmic upheavals that had given birth to the San Francisco peaks, the affair at Sunset was not a particularly noteworthy event. But being perhaps the only volcanic activity to

occur during man's occupation of the region, it may well have created considerable excitement at the time.

We can picture the area's few settlers emerging in frenzy from their pit houses, jolted by recurrent quakes and terrified into speechlessness by the thunderous rumbling and roaring that suddenly engulfed their world. Stealing fearful backward glances as they fled, the last to go probably caught brief glimpses of the fiery hell that had broken loose in their backyard. Perhaps they saw white-hot lava belching from cracks rent in the earth or spouting into the air under



*George A. Grant photo, courtesy National Park Service*

▲ AN OUTSTANDING FEATURE of the main Wupatki ruin is this circular "amphitheatre"

terrific pressure. Millions of tons of fiery rocks, cinders, and ash were blown skyward, while the heavier material settled back to lie beside the new volcano's retching mouth. And the molten lava flowed down the crater's sides until it engulfed the crude shelters the people had so lately called their homes. The lighter cinders and ash, borne high on the prevailing southwesterly winds, came slowly to rest, blanketing 800 square miles of desert with a rich black mulch.

It was this cinder blanket that was later to touch off the land rush. But for a century and a half there seems to have been no need for "Keep Out" signs to prevent the people from settling in this terrifying area. Decades slipped by, and the red men continued to give a wide berth to the wild, black realm.

Then came a day when one of the more bold actually dared to trespass upon the region and discovered that unexpected good might lurk in this ominous-looking, black blanket. Investigation showed that the ground beneath was damp. Moisture! And at a season when only

tinder-dry aridity might have been expected.

Intrigued by the revelation, the eleventh-century agriculturist doubtless gambled a handful of corn and bean seeds, an experiment that brought him a yield far surpassing anything his people had known. Thereupon he succumbed to a trait as old as humanity. He boasted of what he had discovered. And Arizona's first land boom was under way.

This account is admittedly largely conjectural. However, it seems likely that inspiration for the plateau's settlement came about in some such fashion. From the tree ring method of dating, scientists have determined in what year the earlier pit houses were destroyed by the erupting volcano. By the same method it is known when the plateau was settled and when it was subsequently abandoned.

As for the extent of that eleventh-century land rush and the peoples comprising it, that record—written

plainly in red sandstone and open to anyone with eyes to see—is preserved today in Wupatki National Monument, occupying 35,865 acres in Coconino County, Arizona. Within the Monument are situated more than 800 individual ruins, ranging from single-family dwellings to community houses of more than 100 rooms.

Leaving U. S. Highway 89 at a point 28 miles northeast of Flagstaff, we headed the car down a friendly, little dirt road which wound through the junipers, adroitly skirting ravines and quite evidently following the course of least resistance. Like most unimproved desert roads, it was no speedway. Neither was it fringed by billboards and tin cans—certainly enough compensation for a few jolts!

Topping a short, steep rise five miles from the highway turn-off, we found ourselves before the first of the ruins. This was the ten-room pueblo of Nalakihu, a Hopi word meaning "House Standing Alone."





*George A. Grant photo, courtesy National Park Service*

▲ THE FORTIFIED apartment house ruin known as Wukoki, three and one-half miles southeast of the main Wupatki ruin

In 1933-34, five rooms of this low-ceiling building were excavated by the Museum of Northern Arizona, in co-operation with the National Park Service. Two of these five rooms were partially restored. The flat, sandstone slabs used in the construction of the pueblo are laid without mortar. Its floors are of hard-packed earth; its roof rests on sturdy poles of juniper.

Personally, I am not too enthusiastic about restored ruins; to my mind, they have their place—like mounted birds in a museum. A thousand times more preferable is the “real thing” in the rough. In this instance, the “real thing” is Teuwalanki—The Citadel—a marvelous, unrestored ruin that crowns a low promontory immediately back of Nalakihi. Only partially excavated, this impressive old pueblo contains a countless number of priceless artifacts and long-guarded historical secrets that date from its 75 years of occupancy.

Originally two stories high and containing about 20 rooms grouped about a central courtyard, Teuwa-

lanki served primarily as an apartment house. That the building served also for purposes of defense is indicated by its strategic position commanding an unobstructed view of several thousand acres and by the “loopholes” in its sidewalls.

A stone's throw away is a sink hole, believed to have been used in prehistoric times as a water reservoir. And on the terraced slope beneath the ruin appear numerous circles of lava boulders, all thought to be the remains of one-time habitations.

Wherever we looked we saw pottery shards—among the rocks, in the tumbled ruins of the mighty Citadel, on the rocky slopes below it, and in the yard of the pueblo, Nalakihi. They covered a fan-shaped area a half-mile to the north and east of the pueblo. The fragments ranged from dime-sized wafers to a few pieces nearly as large as a playing card, and were all in a remarkable state of preser-

vation despite the length of time they had lain on those desert slopes exposed to wind and rain and snow, freezing temperatures, and blistering sun. On many, the decorative markings were as distinct as though they had been wrought only yesterday, instead of three centuries before Columbus reached America.

From Nalakihi our road rambled on another ten miles to Wupatki (“Big House,” in Hopi), one of the most spectacular pueblo ruins in northern Arizona, and the one longest inhabited in this vicinity.

Located at the base of a rugged, lava mesa overlooking the Painted Desert, Wupatki's red sandstone walls appear to be an integral part of the sandstone outcropping upon which it stands. Partly excavated fourteen years ago by Hopi workmen employed by the Museum of Northern Arizona, the building was found to contain about 70 ground-floor rooms capable of accommodating an estimated population of 150

to 200 persons. Its original height was placed at not less than three stories, possibly more. Its T-shaped doors and small ventilators in the outside wall of the first tier of rooms are characteristic of the Third Pueblo Period.

Wupatki was strategically located and favored with an unfailing spring of pure water, and it was more intensely developed than any other pueblo of the region. At the southeast corner of the building is a rectangular kiva, or ceremonial chamber; and in a hollow at the base of the slope, protected from the prevailing winds by encircling hills, is a large, circular amphitheatre, probably used for dancing and religious ceremonies. By far the most remarkable feature of the place, however, is a so-called "ball court," as yet unexcavated. Somewhat similar depressions situated in the Hohokam country of southern Arizona, are known to have been used for game purposes, but

the Wupatki installation is unique in being the only such pit yet discovered employing stone masonry.

Three and one-half miles southeast of the main Wupatki ruin stands Wukoki, another fortified apartment house ruin. Near the banks of the Little Colorado is located the "Crack-in-the-Rock" pueblo, and scattered over the intervening territory are more than 800 other ruins, the greater portion of them unexcavated.

Although established in 1924, Wupatki National Monument is still undeveloped, with no accommodations for camping and no supplies available for purchase. Eventually the National Park Service plans to install an archaeological display. But until such time, visitors who wish to gain closer insight into the everyday lives of these ancient people should not fail to visit the very excellent Wupatki exhibits in the Museum of Northern Arizona at Flagstaff.

Poring over these interesting displays after our visit to the Monument, we learned that the Wupatki excavations yielded many skeletons of parrots! Scientific examination has identified these as the Mexican military macaw, a type native to Central Mexico below the Yaqui River and approximately 500 miles south of Wupatki. According to museum authorities, the birds were traded into the Flagstaff region. Highly regarded by the red men (possibly even held sacred), they were painstakingly buried at death. Many such burials have been discovered in the ruins.

Flocks of gaudily-colored Mexican macaw screaming from the red sandstone housetops! The scene must have been gay and lively in this eleventh-century homesteader's rush—this melting pot where the lion lay down with the lamb, where pioneer Americans built a thriving community in the fertile lap of a volcano.

## REMINISCENCES OF A CINCHONA HUNTER

*Continued from page 15*

for the trees is *quina*. Many of the forms of cinchona have useless barks, and it was particularly important that *cascarilleros* did not harvest such types and did not mix them as adulterants with better barks. If chemical analyses of our samples showed a sufficient percentage of the bitter alkaloids to warrant harvesting, the information was forwarded to the region where the tree occurred. So, along with surveying went the job of seeing that actual bark exploitation was proceeding efficiently and that the correct trees were cut.

Many of the *manchas* of *cascarilla* were so remote that the *cascarilleros* had to live on the spot in crude shelters of thatched palm leaves. Sometimes a small group of men and boys would spend a considerable portion of the dry season living in the cinchona forests. The heavy work of felling the trees went to the men, while others with machetes or knives peeled off the bark in strips, carried it to the drying area (often a river bank), and spread it in the sun. Drying is a

critical procedure in the harvesting of cinchona bark, for if it is not carried out quickly and thoroughly, some of the bitter alkaloids are lost. Such loss is less important in high-grade quinine barks, but in low-grade barks it may make the lot commercially unacceptable. Drying reduces the weight of fresh cinchona bark by 75%. As quickly as it is dried, it is placed under shelter for protection and to await transportation.

Transportation was one of the toughest nuts to crack in the whole program of wartime cinchona procurement. The long, submarine-menaced sea trip from the coasts of western South America to the processing plants of eastern North America was nothing compared to the vicissitudes of transporting the bark from the forests of the eastern Andes to the Peruvian Pacific ports. The first leg of this journey was the worst, for few roads penetrate the forested montaña. Those that do usually failed to enter cinchona country. At best the *cascarillero* could move his product by mule,

burro, or llama; but often these beasts were unavailable, or trails were lacking. And so, as often as not, the bark had to be carried on human back to a place where pack animals could be utilized. Even then troubles could develop, and it was not uncommon for a mule packing cinchona bark to fall with his load from one of the numerous precipices with which all trails into cinchona country abound. Deaths from trail difficulties were not limited to beasts, for at least one cinchona hunter from the United States died in Ecuador through such an accident.

Eventually the terminus of one of the rough roads would be reached. Here trucks could load the bark and carry it over the rugged Andean backbone to the nearest railroad. At collection depots it was redried, analyzed, sorted, and baled for export; and then one day, after a long ocean trip from the Peruvian ports of Mollendo or Callao, the bark would finally arrive in the United States. Only then was it ready for processing into the white, bitter quinine sulfate which eventually found its way to GI Joe.

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## BOOKS

Continued from page 7

tempted to answer each of these questions. Some authors have succeeded better than others. By restricting his efforts to the amphibians and reptiles of the Pacific states—Washington, Oregon, and California—Pickwell has limited the number of species with which he has to deal, and he has provided adequate means for the identification of the salamanders, frogs, lizards, snakes, and turtles of that region. Notes, drawn largely from his personal observations, supply generalizations concerning the habits and habitats of reptiles and amphibians, but for the individual species there is little precise information. Countless interesting observations or experiments reported in the scientific literature have been ignored or scarcely mentioned.

For instance, the tongue of snakes and of some lizards is described by Pickwell as a "very delicate sense organ—which assists them in checking their environment." He fails to make it plain that it merely carries odorous particles to accessory organs of smell in the roof of the mouth. Since most reptiles shed their skins even though they may not grow, and some turtles do not shed, it is teleological, if not downright inaccurate, to describe the molting of reptiles as an "unavoidable necessity, as the scaly covering [of reptiles] is dry and not capable of expansion." Snakes in the genus *Hypsiglena* do not have grooved fangs, and the gular sac of fence lizards is not "inflated."

The book is reasonably well illustrated, despite the fact that two plates are upside-down, and many of the photographs are inferior. The range of individual species is stated in brief descriptions that are referred to in the key, although there is only one map. On the whole, the questions of what is it and where does it live are answered. But Pickwell's statements of what amphibians and reptiles do and how they do it leave much to be desired.

C. M. BOGERT.

## LETTERS

Continued from page 1

that would make any refrigeration expert turn pale green like the frozen water. Or you may choose to hike out on one of the enormous moraines and see what a load of land a glacier carries on its back. Or just sit and shiver by the glacial lake at the end of the line, where miniature icebergs float and the lake water driven by the wind slaps against the bergs in waves that sound stone-hard.

We also fell into some glacial streams while looking for animal life. They're a peculiar, turbid greenish gray from quantities of rock flour—flat particles scraped from the substratum by the glacier and carried in the fast water. Glacial lakes, including Lake Louise, have this amaz-

## LIFE HISTORIES OF NORTH AMERICAN GULLS AND TERNS

by Arthur Cleveland Bent

Dodd, Mead and Company, \$5.00, 333 pp.

THE early volumes of Bent's admirable Life Histories, of which fifteen have appeared as Bulletins of the U. S. National Museum, are out of print. Yet each of them is indispensable to a serious student of North American birds. Last year the first of the series, on diving birds, was reprinted by Dodd, Mead and Company, with few changes except the omission of the colored plates of eggs.

Now a "trade edition" of the second volume, on gulls and terns, first issued in 1921 as Bulletin 113, has been provided by the same publishers. Again, they have rendered valuable service to ornithologists who lacked this important volume, and no pains have been spared to insure the accurate duplication of the text. There, the divisions into pages are exactly the same as in the original; the type, if anything, is even clearer. That the sixteen colored plates of eggs could not again be included in the volume is readily appreciated, but it does seem regrettable that the 77 plates in half-tone which served so well to illustrate the original edition could not have been retained, as were most of the corresponding plates in the volume on diving birds.

As a work of reference on bird behavior, especially during the period of reproduction, this volume on gulls and terns will, nevertheless, remain extremely useful and authoritative. Mr. Bent's wide personal experience with these birds, from the Atlantic to the islands of the North Pacific, is supplemented by information drawn from the works of many other investigators. He follows each species through the whole year, first its movements in spring, then its courtship, nesting, and the rearing of the young. Further notes on distribution include the fall migration and winter range. The work is a classic. For life histories, consult Bent.

JAMES P. CHAPIN.

ing hue. They reflect the blue of the sky but contribute a definite shade of their own. In many places through the West, where glacial water makes a lake in one valley, rain a lake in the next, the two may be studied from a near-by hilltop and the source of each recognized with ease. We did this between the Jackson Hole country of the Grand Teton National Park and the southern end of Yellowstone National Park, both in Wyoming. We saw the same thing in Washington near Mount Rainier and in northern California around Lassen Peak.

The glaciers on Mount Rainier, by the way, are much more active and gave us something of a scare. We hiked a mile to the foot of one on an afternoon when no rain had fallen for a week or so.



From Three Lions

#### ▲ A STUDY IN TREES, by Ursula Meyer

Without recognizing what it was, we found a steep hillside at the end of the valley. Before our eyes the whole thing began to crumble away. Great boulders tumbled down a muddy slope, almost to our feet. Each must have weighed tons. Little rocks came even faster. There was no sign of ice, but a glacial stream rushed from below the semicircular bank and showed that this was indeed the glacier, hidden under a thick layer of transported rock and earth. It showed no beautiful, white snow or streaks like those in Professor Flint's pictures. Then the following night there was a hard shower; and when we returned to this glacier at the suggestion of a ranger, the mud had been washed from its face. Although more rocks were falling, leaving dirty streaks, an enormous bank of green ice over 50 feet high glittered in the morning sun.

NATURAL HISTORY Magazine readers with itchy tires will be glad to know that there are good glaciers to examine within the boundaries of our western states and adjacent Canada, which can be reached without boat, chartered plane, or pack trip.

LORUS J. and MARGERY J. MILNE.  
Burlington, Vt.

#### *Hummingbird Impersonator*

Sms:

Recently I read that the only hummingbird found east of the Mississippi is the Ruby-throated Hummingbird. This makes me wonder what I saw last summer at Lake Stockholm in Sussex County, New Jersey.

This little creature, hovering and darting about as hummingbirds do, appeared almost daily in a near-by flower garden during a good part of August. It seemed rather small even for a hummingbird. What held my attention was the complete lack of protruding tail feathers, which gave it a very stubby appearance. When moving about, it seemed more like a very large bee.

After a time, I waited for it with glasses and was surprised to see that its beak was bent downward at about the middle to form a right angle. This arrangement was not inconvenient; the creature simply settled over a flower as would a tiny helicopter, its wings a blur of motion. With the glasses it was possible to see that its head was like a hummingbird's in shape and that there were no protrud-

ing tail feathers. Its back appeared to be solid green, but it might have been iridescent.

Could someone identify this little creature?

F. C. MARTIN.

Ridgefield, N. J.

Dr. John T. Zimmer of the Bird Department at the American Museum answers this question by saying: "It is quite certain that this was not a hummingbird but a 'hummingbird-moth'—one of the sphinx moths that are so often mistaken for birds. Their actions in flower gardens quite understandably confuse many observers, for they behave like hummingbirds and are much the same size. The 'tail' is stubby, and the 'bill' is a long proboscis (much longer than a Ruby-throated Hummingbird's bill). When thrust into a flower, it may be coiled under the head or extended nearly straight. And on occasion it may be half bent, giving somewhat the appearance described. The wing action is very rapid. Queries similar to this one are fairly frequent."

Further information is offered by Wil-



Hugo H. Schroder photo

▲ RACCOON JUMPING from a hawk's nest 35 feet up in an oak, where it had been sleeping. Upon alighting, the animal ran away and disappeared in the palmettos

liam P. Comstock of the Museum's Department of Insects and Spiders:

"The commonest moth in this area that would readily be mistaken for a hummingbird is named *Pholus pandorus*. Specimens with a wingspread of  $2\frac{1}{2}$  to 3 inches may be seen. These moths can be observed at dawn and dusk, particularly around phlox. A larger and much more brilliant moth that occurs more in the South is *Pholus labruscae*. It is blue on the hind wings and would appear big for a hummingbird, measuring about 5 inches or more across the two wings."—Ed.

#### More on the Tarsier

In response to our one-page feature on the tarsier in the December, 1947, issue of NATURAL HISTORY Magazine, the following letter was received from Mr. C. Ackley Brower of Birmingham, Alabama, who poses some provocative questions. The letter is interrupted at intervals to give the answers of T. Donald Carter of the American Museum's Department of Mammals.—Ed.

Sirs:

I believe it would be of great interest to your readers if some authority wrote an extended article about the tarsier with more pictures. The photograph and brief description you published were fascinating, but they left many unanswered questions. I looked up the articles in the eleventh and fourteenth editions of the

*Britannica*, but they gave little more information than your description. For instance:

**Question:**

What is the purpose of the reefing muscles in the ears—to reduce air resistance when jumping?

**Answer:**

Undoubtedly this reefing is for the purpose of protecting the ears when the tarsier is jumping and traveling through the dense bushes that characterize their habitat.

**Question:**

The picture shows only three digits on the left hind foot. Are there more?

**Answer:**

There are five digits on both the fore and hind feet.

**Question:**

Are the bright spots to the left of the pupils reflections of the sun? At night, I would expect the pupils to expand to cover the whole area of the eye.

**Answer:**

In darkness, the pupils would expand to cover most of the whole eye area. But the bright spots are reflections of a flash bulb, which was used even though the photograph was taken in the daytime.

**Question:**

Is the creature timid in the presence of man? And will it live in captivity?

**Answer:**

In the wild state the tarsier is not especially timid, but being nocturnal, it is seldom seen. There are two live specimens in the New York Zoological Park where the picture was taken. The Zoological Society in Philadelphia also has two live specimens.

**Question:**

Are the "adhesive" surfaces on the fingers some kind of sticky substance, or are they suction pads?

**Answer:**

There is serious doubt whether the things generally referred to as adhesive surfaces on the foot of the tarsier are actually adhesive in any way. A thoroughly competent observer who has had the opportunity to watch the animal closely at the Zoological Park in The Bronx, N. Y., informs me that they have never seen the animal use these surfaces for security in jumping or climbing. The tarsier customarily holds to limbs by grasping them.

**Question:**

How far can the tarsier jump?

**Answer:**

I do not know, but I have seen a galago, a small lemur of about the size and build of a tarsier, leap from a table to a tree trunk over eight feet away. Undoubtedly a tarsier could do as well or better.

**Question:**

Is the tail prehensile?

**Answer:**

No. It is long and nearly naked, with a tuft of hairs at the end.

**Question:**

Is the animal becoming extinct?

**Answer:**

The tarsier appears to be quite local, but it is fairly common in certain districts of its range.

#### Conical Hailstones

Sirs:

During a thunderstorm last August 28, we were much surprised by a quite heavy fall of cone-shaped hailstones, which to us was a new experience. Inquiring among friends and acquaintances, I could find no one who had ever seen or heard of hailstones in this form. So we are wondering if it is not an unusual phenomenon.

Toward evening of August 28, while my husband and I and another party were camping on Bear Creek, Crook County, Oregon (the high plateau region of central Oregon), a sudden thunderstorm came up. A rather heavy rain with thunder and lightning was followed by hail of the usual small, round pellets. After about ten or fifteen minutes of the smaller hail there was a lull; and then a real battering on the metal roof of our trailer began, and the ground was quickly covered with the large, cone-shaped hail.

The hailstorm subsided after about ten or fifteen minutes, and my husband de-



cided to take a picture of one of the hailstones. He picked one up from the ground and handed it to me. I was much surprised to find that it was a perfect cone, slightly rounded on the bottom but with straight sides that tapered to a fairly sharp point at the top. It measured one inch in length after slight melting.

Our friends, who were camped in a tent, reported that each hailstone made quite a dent in the tent top as it struck. The hailstones must have fallen with the blunt end down, for had they fallen point down, they surely would have riddled the tent.

As I understand it, hail forms in concentric layers of ice because the hail-

stones are repeatedly carried upward and downward by air currents, and the accumulation of moisture in warm strata of air freezes in higher, colder strata. Thus the stone grows in size until it is too heavy to be supported by the air currents and falls to earth. How do hailstones with a perfect cone shape fit into this picture? They were quite hard and firm.

I would appreciate knowing if cone-shaped hail is not unusual and the why for it.

(Mrs.) EDITH R. McLEOD.

Klamath Falls, Ore.

The following information is offered by Harry Wexler, Chief of the Special Scientific Services Division of the United States Weather Bureau:

Conical hailstones have been reported and recorded a number of times, although they do not occur frequently. In April, 1938, in Washington, D. C., hailstones fell that were roughly hemispherical at one end and conical at the other. They measured somewhat less than an inch and a half through the vertex of the cone. Meteorologists described them as

triangular pyramids with spherical bases, distinct faces, and dihedral angles of various sizes.

The explanation offered at that time suggested that in general the stones had been formed as Mrs. McLeod has explained but around an initial, irregular core. It was believed that the hailstones continued to develop unsymmetrically, with the flattened face kept continually against the air current that bore them. However, this theory appeared to contradict the actual facts, because the successive layers of ice built up around these stones were incomplete, and the centers of curvature of the circular arcs of ice were located at the apex of the cone.

In 1926, two Germans, Hann and Süring, wrote of similar hailstones which had the appearance of being formed by the explosion of larger balls of ice. Still other observers believed that the same effect might have been produced by the collision of larger, rounded stones against one another in the upper air. This hypothesis—that conical stones were originally much larger and spherical—seemed to explain satisfactorily the observed internal structure of the stones and to

satisfy certain mathematical requirements involved. It is generally believed more valid than the theory that presupposes initial irregularity in the nucleus of the hailstone.

A scientist at the General Electric Research Laboratory wrote an article, published in *Nature Magazine* in 1938, stating that the shapes of these stones and their stratification showed plainly that they were fragments of larger, spherical stones about 300 millimeters (1 1/8 inches) in diameter, in which clear and cloudy layers had alternated about every two millimeters. He concluded that the fracture of the large stones took place at high levels, judging from their terminal velocities, but the absence of clear and cloudy ice built onto each fragment seemed to prove that the stones were fractured below the region in which they were formed.

In the latter study, the fall of hailstones investigated was remarkable for the fact that all the stones were conical at the place of observation, whereas a mere two miles away only complete spherical stones fell. Another of the research engineers at the Laboratory sug-

By HUGO H. SCHRODER

THIS photograph is one of a series the writer took to illustrate the life history of the Florida Burrowing Owl. The events that led up to it were rather interesting. A nest burrow near Lake Tohopekaliga, Osceola County, was opened in order to photograph the eggs in the nest. The female owl remained in the burrow, and it was therefore possible to secure a photograph of the bird with some of the eggs showing.

After taking a number of pictures, the nest chamber and tunnel were given a light-tight and weatherproof covering. On returning to the owl nest some weeks later in the hope of finding well-grown young, we discovered that the owls had not approved of our covering for their home site. They had excavated a new tunnel that ran nine feet from the old nest, and had constructed a new nest chamber at the end of it.

In it we found five large young-

sters, just about ready to leave home. A photograph was taken of the quint as they huddled in the nest chamber, after which additional pictures of them were taken in the open. Many bird youngsters are difficult subjects to keep before

the camera, but these owl babies remained wherever they were placed. After they had posed for the camera, the five young owls were returned to the nest chamber, and the entire burrow was covered as on the previous visit.

## OWL QUINTUPLETS



► UNLIKE MANY YOUNG BIRDS, the Burrowing Owl quintuplets posed patiently for the camera





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gested at the time that the shattering of the stones was possibly caused by a pressure wave set up by a bolt of lightning that passed near them as they fell. The fact remains, however, that a fall of conical as well as other shaped hailstones that took place in Williamstown, Massachusetts, in August, 1938, was accompanied by almost no thunder and lightning. So it must be said that we are still gathering evidence on which a completely satisfactory explanation can be based.

• • •

### Teaching Aid

Sirs:

As a teacher of biology, I find your Magazine both stimulating and helpful. During the past year, it seemed that each issue contained an article that could be definitely related to some phase of our classwork. The covers are very fine for bulletin board material. My students are always interested in the new copies that come to me and the school library. Many articles are an inspiration for our future naturalists.

MARY LOUISE BARCLAY.

Burley, Idaho

• • •

Sirs:

The enclosed check for \$4.00 is for 1948 membership. I am much interested in all forms of life, past and present. Your magazine contains authentic information for those who care to read it carefully. While I have been a member only a year, I would regret not reading this excellent magazine.

CLARE G. MEYER.

Hastings, Neb.

• • •

Sirs:

I am changing the Associate Membership of Dr. Arthur E. Lamb to Annual Membership, and we would also appreciate having it put in my name instead of Dr. Lamb's, as I am really the interested member of the Museum and reader of *NATURAL HISTORY*.

As for the Magazine, it is utterly impossible to express the keen delight and anticipation with which I look forward to each copy. Other publications of a similar nature and in more or less the same price group are not even remotely comparable to *NATURAL HISTORY*.

It always surprises me that the combination of such fascinating reading matter, superb photography, and excellent print and paper can be offered for the low figure of \$4.00 a year.

Perhaps my conscience is guilty for my having had so much enjoyment for so little money during the past thirteen years and it now impels me to subscribe to a slightly higher membership even though I may not be able to take advantage of the more extended privileges that accompany it.

(Mrs.) LORETTA DE M. LAMB.

Brooklyn, N. Y.

## MUSEUM ACTIVITIES IN THE FIELD

### Exploration for Insects

Lack of space in the last issue of *NATURAL HISTORY* Magazine prevented a report on the diverse activities of the American Museum's insect scientists in widely separated parts of the Western Hemisphere. Early in October an expedition returned from northern Mexico with the most comprehensive and varied collection of insects and spiders ever obtained from this area. Dr. Mont A. Cazier, leader of the party and Chairman of the Museum's Department of Insects and Spiders, estimated the total number of specimens collected at more than 100,000, which includes at least several hundred new species.

Among the unusual additions to the Museum's entomological collections are bizarre Velvet Ants, beautifully colored Scarab Beetles, Trapdoor Spiders, the famous Durango Scorpion, whose bite has proved fatal to many children, and fearsome looking specimens of the Vinegaroon or Whip Scorpion, which reaches a length of almost half a foot. Of great importance, according to Dr. Cazier, is the collection of more than 1,000 *Moneilema* Beetles (sometimes called Cactus Longhorn Beetles), an insect that lives in cactus plants and represents an unusual type occurring in southwestern United States and northern Mexico.

This expedition to northern Mexico was one of four organized for field work in entomology by the American Museum. The other three were detailed to Guatemala, Peru, and southern Mexico. According to Dr. Cazier, the work of these groups during the summer has resulted in one of the most successful periods in Museum entomological history. The research program was financed by Dr. William Procter, a trustee of the Museum, Mr. Frank Johnson, and Dr. David Rockefeller, as a public service in the interest of science.

Also completed is the expedition to Guatemala, conducted by Dr. and Mrs. Charles Vaurie of the Museum's ornithology and entomology departments respectively. Their collection includes insects from areas unexplored since the end

of the nineteenth century. The specimens secured range in size from pin-point beetles, barely visible to the human eye, to huge ones 4 inches long.

Mr. John C. Pallister's expedition to Peru, previously mentioned in *NATURAL HISTORY*, netted the Museum collections more than 28,000 specimens, including many new and rare ones.

A fourth expedition headed by Borys Malkin completed a successful expedition to southern Mexico during which about 18,000 specimens of insects and spiders were collected in the states of Guerrero, Oaxaca, and Nayarit.

A search for the reputed deadly Durango Scorpion was not without its dangerous moments. Dr. Willis J. Gertsch, one of the world's leading authorities on scorpions and spiders, was nipped by his prey in the Durango area. Luckily the scorpion wound received by Dr. Gertsch was delivered by a near relative of the Durango Scorpion rather than the notorious type itself. Nevertheless, Dr. Gertsch was incapacitated for a number of days, with one arm temporarily paralyzed.

An extraordinary discovery of interest to geneticists was the find by Dr. Herman T. Spieth in northern Mexico of a *Drosophila* fruit fly with an entirely new chromosome pattern.

Dr. Charles D. Michener was successful in obtaining many interesting specimens of the large Saturnid Moth, one of the most colorful of all the insects.

On November 4 a field group from the American Museum of Natural History left for Panama to uncover secrets of the carnivorous, marauding Army Ants. Dr. Theodore C. Schneirla, Curator of the Museum's Department of Animal Behavior and one of the world's foremost authorities on the physiology of ants, is leading the expedition, which will spend five months on Barro Colorado Island in Gatun Lake and in the Darien country of eastern Panama studying the most predatory of ants.

One of the most interesting phases of Army Ant behavior which still remains a mystery to science is the way in which the queens of the ant colony are formed.

### SUBSCRIPTION NOTICE

For several years, the mounting cost of paper, engravings, printing, and other things connected with the production of a magazine have made it increasingly difficult to publish *NATURAL HISTORY* at the annual subscription price of \$4.00.

It now becomes necessary to announce that, beginning February first, the dues for Associate Membership will have to be \$5.00. The American Museum makes this announcement with great reluctance and only after making every effort to avoid an increase. We trust that our Members, who have shown such loyalty through the years, will realize that we are offering the magazine at as low a figure as current conditions permit.

F. TRUBEE DAVISON, President,  
The American Museum of Natural History.



Dr. Schneirla suspects that the queen ants become queens through the relatively simple process of eating more than other female ants. He also plans to attempt to determine how and why the queen ants possess the ability to produce broods at regular intervals of 36 days throughout the year. All of these broods except one consist of approximately 30,000 non-reproductive workers. The one exception to this huge brood production, however, is a single male group of around 3,000 which is born in the dry season. The brood containing queens may prove to be one more exception. As a result of several past seasons of study on Barro Colorado, Dr. Schneirla believes that only one brood a year contains queens. He also feels that it is logical to suspect that this smaller brood produces all or most of the queens because there are few new ants competing for the same food supply.

Dr. Schneirla has previously observed huge colonies of 65,000 or many more Army Ants marching through tropical rain forests in narrow, hurrying columns or large, sweeping masses. Some of the ants in this highly military society go out on forays for food and return with prey for the central colony. The Army Ants move in columns that are sometimes 300 yards long. They go on the march nightly for about 17 days in a regular cycle. Then the colony settles down for a 20-day stop. As the Army Ant column moves, it destroys everything in its path and sends out flanking columns in several directions for scouting and for securing additional food.

Dr. Schneirla is accompanied by two other scientists, Dr. Ernest Enzmann of the Massachusetts Institute of Technology and Dr. Robert Z. Brown of Swarthmore College.

The expedition has established research headquarters at Barro Colorado in the Canal Zone, where for many years a field laboratory for biological studies in the near-by jungles has been maintained through the co-operation of several scientific institutions.

### **Expedition to Australia**

The first major American expedition to the remote Cape York Peninsula in Australia will be conducted in 1948 by scientists of the American Museum of Natural History. The expedition, led by Leonard Brass, botanist, will begin operations in the Cape York territory some time in March, following a preliminary reconnaissance of the area.

Known as the 1948 Archbold Cape York Expedition, this is one of a series of biological investigations in Australian and New Guinea areas conducted by Archbold Expeditions, an organization established by Richard Archbold and affiliated with the American Museum of Natural History. According to Mr. Brass, the group of scientists will concentrate

most of its attention on the collection of mammals and plants, although amphibians, reptiles, and insects will also be sought for the Museum's collections.

Dr. G. H. H. Tate, Curator of the Museum's Department of Mammals, will join the expedition in Cairns, North Queensland, in mid-March. Dr. Tate is already en route to Australia, where he will conduct preliminary surveys and studies as part of the over-all project in New South Wales and in southern and western Queensland. Dr. Tate will be in charge of the expedition's mammal collection and field study and will be assisted by Mr. Hobart M. Van Deusen, also of the Museum's Department of Mammals.

Geoffrey M. Tate, in charge of the New York headquarters of Archbold Expeditions, will supervise the expedition's transport and supplies, in addition to collecting reptiles and insects. Mr. Tate states that plans for this latest Archbold Expedition have been under way for almost a year. Its equipment and supplies fill eighteen crates, and its purchasing and organization have provided many unexpected difficulties.

According to expedition leader Leonard Brass, it is quite probable that the group's activities in the remote Cape York area will uncover a number of new species, previously unknown to science; and it is almost certain, he believes, that many new botanical species will be discovered. The plant collections will be deposited at the Arnold Arboretum of Harvard University. Seeds of palms and other ornamental plants will be collected for cultivation at the Fairchild Tropical Garden in Florida.

In the mammal field, in addition to wallabies, kangaroos, phalangers, and the unusual tree-climbing kangaroos, it is expected that the group will probably find new forms, particularly among the small mammals.

The party will establish a series of bases connected by water on the eastern coast of the Peninsula. From preliminary surveys, Mr. Brass believes that the most interesting and profitable areas for collecting will lie in the more northern part of the Peninsula, between Coen and Somerset. The group will cover not only the tropical rain forest areas of the eastern coast but will work westward into the open eucalyptus forest country, thus making possible a wide coverage of the different biological environments of the Peninsula.

Mr. Brass left New York on December 8 for San Francisco, and from there he will proceed by steamer to Sydney and thence northward. Mr. Tate and Mr. Van Deusen will sail in January to join the rest of the party in Cairns.

Australians, both in Government circles and in the sparsely populated Peninsula, have been most helpful and co-operative in all preliminary negotiations.

### **To Primitive Africa**

A comprehensive program of scientific work is planned for an American Museum expedition to Equatorial Africa now assembling in the field. Mr. Brayton Wilbur, who is sponsoring the expedition, is scheduled to leave the United States near the first of the year for Nairobi, where Dr. James L. Clark, Director of the American Museum's Department of Preparation and Installation, has been for some weeks making preparations for the safari. Mr. Wilbur, a prominent West Coast businessman and President of the San Francisco Chamber of Commerce, will be accompanied by his 10-year-old son.

The expedition will penetrate the remote southwestern Sudan and the adjoining area of southeastern French Equatorial Africa—one of the few remaining parts of unspoiled, native Africa that has never been thoroughly explored by scientists. The party expects to bring back the first motion pictures ever taken of some of the remote tribes in this part of Africa and to conduct studies on the almost extinct white Rhino which, next to the elephant, is the largest of all land mammals.

Dr. Clark has always argued that it is safer in Africa than on Fifth Avenue, but a letter from him asserts that the Dark Continent seems to be becoming a perilous place with the inroads of civilization in recent years. Robbery and violence have become prevalent in some sections, and post-war confusion has introduced new problems in the outfitting of a scientific expedition. He had not even been able to secure a warehouse in which to assemble the equipment.

On December 30, two other members of the expedition were scheduled to sail on the S. S. "America"—Dr. Neal A. Weber of Swarthmore College and Mr. Murl Deusing, a well-known photographer and the Curator of Education at the Milwaukee Public Museum. They expect to fly from London and arrive in Nairobi Jan. 12.

Dr. Weber is one of the world's leading authorities on the biology of tropical ants and other insects and a veteran of tropical exploration. The major part of his field work will center on studies of tropical insects that play a part in the transmission of diseases. Mr. Deusing will direct the expedition's photographic activities.

The entire expedition will comprise at least 50 persons, including more than 35 natives for the specialized field work. Dr. Clark's field manager will be Captain Vivian Ward of Nairobi, who will also serve as liaison officer between the expedition and native chieftains.

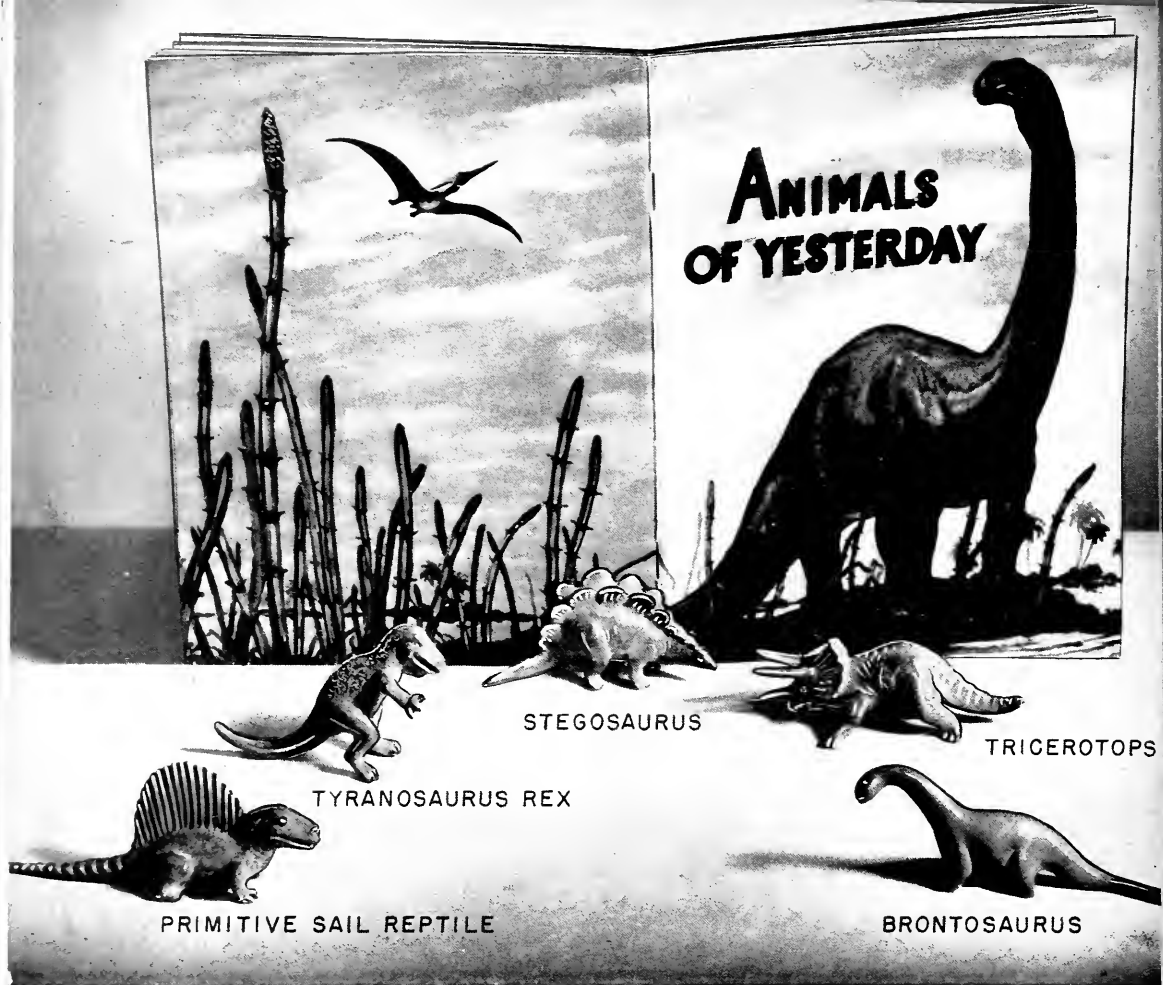
It is expected that the forthcoming venture, known as the American Museum of Natural History's Central African Expedition, will uncover new species for science, especially among the snakes, insects, spiders, lizards, fishes, small mammals, and birds.



February **NATURAL HISTORY** 1948

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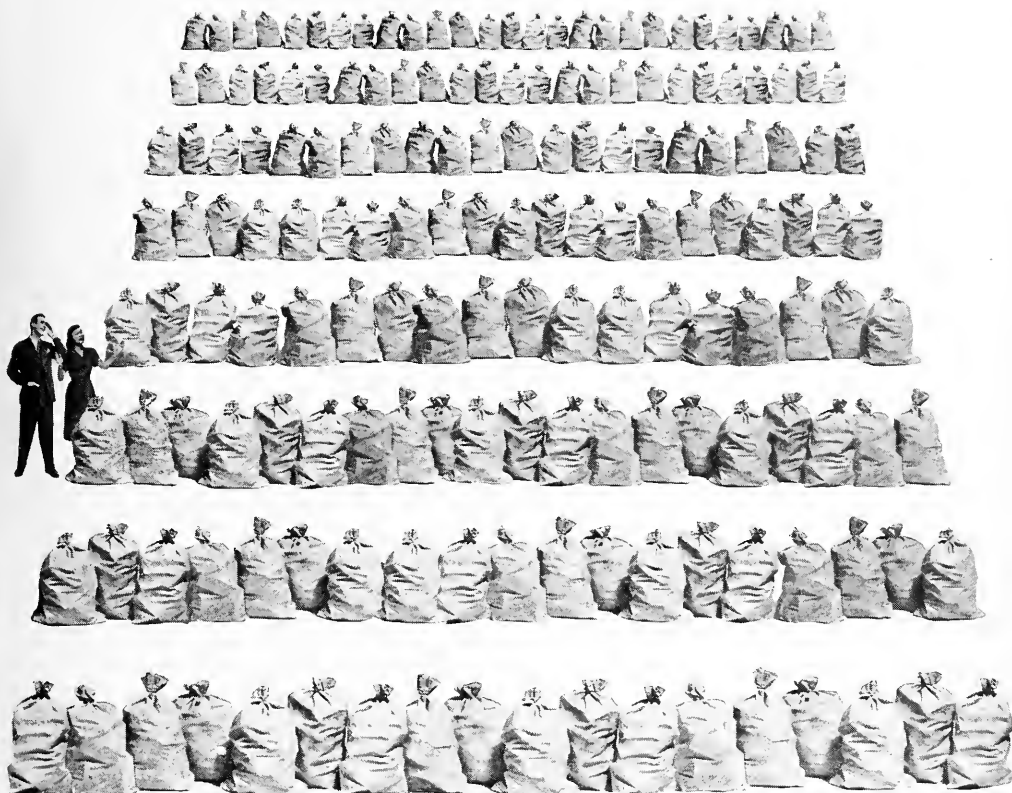
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# LETTERS

## Ice Shirt Front

SIRS:

Your readers may be interested in this photograph of an "ice collar" held in the air by two trees on the bank of the Genesee River in Rochester, New York. The "ice collar" was formed when the river was at that level. When the water subsided, this curious formation was left about four feet above the river level as shown here.

You may recall that in January, 1947, you published a picture of some much smaller "ice collars," taken by Mr. Thomas F. Fisher of Schenectady, New York. If Mr. Fisher's picture is of "ice collars," mine is of an "ice shirt front."

JAMES B. CUMMINGS.  
Rochester, N. Y.



▲ "MAGNETIC" TERMITE NESTS. The insects in Australia that build these slab-shaped nests always place them in a north-south direction. Quite naturally they have come to be called compass nests, but a more likely explanation is that the termites act in response to the rising and setting sun. The photograph was recently taken by the explorer Carl Vonhoffman



▲ AN "ICE COLLAR" of remarkable size, four feet above present water level. An unusual photograph taken by J. B. Cummings of Rochester, N. Y.

## Day Shift for the "Night-Blooming Cereus"

DEAR DR. ANTHONY:

I read with considerable interest your article in the January issue of *NATURAL HISTORY* in connection with *Hylocereus undatus*, or, as it is commonly called, the "night-blooming cereus."

I think the current reproduction of the flower on the cover of the magazine is a magnificent job, which really shows the flower in all its gorgeous beauty.

... I know you will be interested in a successful experiment that I have made in prolonging the time the flower stays in full bloom. The procedure I have adopted is as follows.

At dusk, just about when the top of the flower commences to open a tiny bit, I cut it off about  $\frac{3}{4}$  of an inch from where the stem meets the vine. This is done with a sharp knife and at an angle of about 45 degrees. The flower is then placed in a widemouthed container, filled with water up to the base of the flower,

and put in an entirely dark room. In about an hour and a half the flower has completely unfolded. I then move it to a lighted room so that its beauty can be enjoyed. Before going to bed, the flower and its container are placed in the Frigidaire about an inch away from the freezing unit, where it remains all night. The next morning it is taken out of the Frigidaire and is on display in the daylight throughout the entire day, during which time it retains its form and all its beauty. The second night the flower dies . . .

BERT W. HENDRICKSON.

Bradenton, Fla.

DEAR MR. HENDRICKSON:

Your friendly letter has been received, and it is very gratifying to learn that you think the color reproduction of *Hylocereus* is praiseworthy and that the explanatory text is interesting.

Your technique for prolonging the fugitive life of the blossoms interests me greatly. As a hobby I grow quite a variety of cacti and succulents in a small greenhouse, which has to be heated during our New Jersey winter . . .

In the New York Botanical Garden there are several very large plants of *Hylocereus undatus* and other species, and many of the flowers open each year. However, in this heated house the visitors never see an open flower. By the time they can enter in the morning, the large collapsed mass is the only evidence that something has happened during the dark hours. I know because I have been the first one in on some of these mornings.

An experience with an *Epiphyllum* late this fall confirms the effectiveness of your method of holding the open flower of "night-blooming cerei." A large bud was

*Continued on page 52*

# NATURAL HISTORY

*The Magazine of the American Museum of Natural History*

FREDERICK TRUBEE DAVISON, President

ALBERT E. PARR, Director

VOLUME LVII—No. 2

FEBRUARY, 1948

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*What is the one word that makes birds and animals into plants?*

You will find NATURAL HISTORY Magazine indexed in *Readers' Guide to Periodical Literature* in your library



## THE COVER THIS MONTH

This little Navajo girl is a member of a tribe that makes up one-sixth of the country's Indian population. They are famous for their hand-wrought silver jewelry and for their Navajo blankets, such as the one on which she sits, which are woven from the wool obtained from their many flocks of sheep. Although grazing is their main occupation, the Navajos also raise corn and other crops where there is sufficient moist soil in their arid reservation lands, in northern New Mexico and Arizona.

Increase in the Navajo population partly accounts for the fact that there are now more Indians in the United States than in 1492. Public protest about the poverty of Indians on reservations caused Congress last December to vote \$500,000 for emergency relief. Of this, \$250,000 has been allotted to Navajo reservation funds to be used for increased welfare services.

With the Navajo's present mode of life and the funds ordinarily available, the reservation lands can hardly support the tribal population. However, the Department of the Interior has plans for a ten-year rehabilitation program, involving \$80,000,000, to develop the land and provide better education and welfare services. This would raise their living standard and help them improve their lot.

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EDITOR: Edward M. Weyer, Jr., Ph.D.  
Elizabeth Downes, *Editorial Assistant*.  
Atherlie E. Karp, *Editorial Assistant*.

ART AND PRODUCTION: Robert E. Williamson.  
Jean Bruck, *Assistant in Art and Production*.

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*The American Museum is open to the public every day in the year without charge*



Hugo H. Schroder photo

▲ WHITE PELICANS in flight over the rookery. Bird Island (National Audubon Society Sanctuary), Laguna Madre, Texas

## LETTERS

*Continued from page 50*

scheduled to open the evening I held a conservation meeting in my home at Englewood, New Jersey. The potted plant was in a room where the light was subdued, and I called attention to the only slightly open bud and suggested that they glance at it occasionally. The flower lived up to my prediction, and at the end of our meeting was fully open—a huge pink flower that was something quite outside the previous experience of these people. I wanted other friends to see it, but I knew that if the flower went back into the greenhouse it would be spent in a matter of hours.

The pot was placed in the vestibule where the temperature was decidedly on the cool side, and the light was reduced during the day. The flower lasted about three days under these circumstances.

I have wondered what would happen if I gave cactus flowers the ice-box treatment; also when I could cut a bud with the certainty that it would open. Your letter tells me these two things, and my next "night-blooming cereus" will get a chilly reception!

HAROLD E. ANTHONY,  
*Department of Mammals.*

American Museum of Natural History,  
New York, N. Y.

### **Woodpecker's Roof?**

SIRS:

I venture to ask you a question. I have seen a woodpecker hole in a tree directly beneath a semicircular fungus, which projected like a roof over the hole. A student of mine also reported a similar case. Does the bird intentionally pick the place under the fungus growth, or does the fungus growth develop as a result of the hole?

DR. H. HARTWIG.

Bielefeld (English Zone),  
Prussia.

This phenomenon is interesting, but I feel sure that it is purely accidental. I have never heard of a woodpecker deliberately choosing such a site, although one might, of course, do so without being influenced one way or the other by the bracket-fungus. If the presence of a hole in some way caused the fungus to grow there, we should expect to find the two things together more often.

Since woodpeckers commonly make their nests in dead wood, and since some bracket-fungi also grow on dead wood, the occasional juxtaposition of nest and fungus is not surprising.

JOHN T. ZIMMER,  
*Department of Birds,*

American Museum of Natural History,  
New York, N. Y.

### **"Window-Fighting"**

SIRS:

Very rarely the Wood Thrush spends a day or two in my garden when on migration in autumn. It never lingers here more than a few days. However, this year I noticed a solitary thrush in mid-October under a camellia shrub. Early the next morning, he began hurling himself against my casement windows—at his reflection probably, as the glass is on the outside and the screen within the room. For three weeks he kept up these attacks from morning until dark, barely snatching at food for a moment now and then. Then, for a fourth and fifth week, he attacked less steadily, but



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he never missed a day. Now in mid-December, two days may pass without attack; then, at dawn or in the late afternoon, I again hear his heartbreaking attack upon his reflection.

His mate was probably killed by a neighbor's cat, for I hear that the cat brought in a thrush several weeks ago. Evidently he thinks his reflection is another male who has robbed him of his mate; does he not? But why does this lonely, unhappy thrush not forget and go on to find the other thrushes at the end of its usual migration? How long does it carry a memory of its mate?

What strength, what limitless vitality, this lonely, unhappy bird must have to stand its earlier unceasing assaults upon the window! It left blood upon the pane! I did not imagine a bird remembered so long.

HARRIET JOOR.

Lafayette, La.

The following comments are offered by Dr. John T. Zimmer, of the American Museum's Bird Department:

"Window-fighting" is a common trait of many birds as a part of their defense of territory from encroachment by males of the same species. They mistakenly take

their reflection for such a rival. It has nothing to do with the loss of a mate. In any case, I think the Wood Thrush does not mate for life and has no interest in the opposite sex in nonbreeding time.

The particular interest in the present report is the season, since breeding time is by then past and there is no territory to defend. I have heard of no similar case. Whatever the reason, I seriously doubt its connection with any other bird that was killed by a cat. It is highly questionable that such another bird could properly be considered as a "mate."

### Natural History Travels Far

Sirs:

It occurs to me that you may be interested in the following, which reflects the wide influence of your magazine.

For several years I have given an Associate Membership to a young lad who is now teaching in a college in Georgia. He has always enjoyed the magazine and recently tells me that he is "now able to share it with my kids, inasmuch as I cannot take them through the institution as you used to take me. The magazine helps immensely in making the natural sciences alive and appealing and not just a lot of dry facts in a textbook."

This lad has been teaching in Georgia since his war service.

MRS. ROBERT RIDGWAY.

New York, N. Y.

**NOTICE**—Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on these pages will be paid for at \$2.00 each, with full credit to the photographer. Return postage must be included.

Sirs:

I send NATURAL HISTORY each month to a British friend, an ex-college president and a naturalist . . . My friend's daughter writes in a Christmas letter as follows:

"Father thanks you very much for the NATURAL HISTORY Magazines. He enjoys them very much, and they are extremely well done. After we have all enjoyed them, I send them to the Seaman's Hospital at Greenwich, where there are patients of all nationalities . . ."

H. ERNESTINE BULGER RIPLEY.

Pelham Manor, N. Y.

o o o

Sirs:

. . . I find your magazine most interesting and instructive. My brother-in-law, Mr. A. M. Jabrskie of Plainfield, New Jersey, subscribes to it and hands the copies on to me. When I am finished with them, I send them to my daughter,

Continued on page 95

▼ "CHAMOIS PARADE": a photograph taken in Switzerland by B. Schocher





# YOUR NEW BOOKS

MEXICO • HUNTING AND ADVENTURE • ARABIAN HORSE  
NATURE HOBBIES • GUATEMALA • SIERRA NEVADA

## NOW IN MEXICO

----- by Hudson Strode  
Harcourt Brace and Co., \$5.00  
368 pp., 32 illu. str.

IN a series of essays, Mr. Strode writes in this book of his visits to Merida, Acapulco, Patzcuaro, and Oaxaca, of his experiences at a bullfight in Mexico City, of his visits to the studios of Diego Rivera and Orozco, and of many other of the more interesting places and scenes in Mexico. It is a pleasurable and instructive personal record of his travel and observations with bits of history and anecdote intermixed.

Although not explicitly labeled as such, the book was obviously intended to serve as an introduction and guide for the American tourist in Mexico. With few exceptions, the places selected for description are on the well-traveled tourist routes, and the point of view is almost always, as it would be for the tourist, from the paved highway or from the windows of a good hotel. These are not exactly the vantage points to afford an intimate inspection of Mexican life and customs, but they have their advantages, and they result in a point of view exactly suited to the purposes of the tourist.

In speaking of this book as a guide for the tourist, I do not mean that it is a guidebook in the ordinary sense. More important than that, it is the record of a very perceptive traveler's impressions and attitudes toward the things he has seen and done. It will serve the necessary purpose of awakening the tourist's interest in many things he might otherwise pass by without a glance and will orient his thinking in regard to the bewildering strangeness that always confronts a newcomer to Mexico. It is a skillfully written and sound book, which I highly recommend to anyone planning a trip to Mexico.

GORDON F. EKHOLOM.

## THE BOOK OF NATURE HOBBIES

----- by Ted Pettit  
Didier Publishers, \$3.50  
280 pp., 133 illu. str.

MR. PETTIT, in this book, draws upon his background as nature enthusiast for twenty years, during which time he has led boys and girls as well as adults into the secret of making friends with the world outside our windows.

By a thoughtful and selective use of tested nature activities, he has compiled a book of easy-to-do hobbies. It is not a textbook, nor is it a complete introduction to nature study. There are more than two hundred projects presented, covering such subjects as fishing, wild flower gardening, bird watching, nature crafts, wild animal pets, as well as many others.

The easiest and best "things-to-do" that will help others find out how interesting nature really is are simply described in this one volume.

The author has been fortunate in his choice of illustrations as well. The drawings by Don Ross are informative and easy to follow. They show in an interesting manner consecutive steps in the construction of many things, such as birdhouses, bird feeders and blinds, collecting nets, insect mounting boards, and spray or spatter prints of leaves.

The basic idea of the book is to show clearly the way a very small amount of equipment can be utilized for all sorts of nature hobbies—hobbies that on the surface are fun to follow but at the same time are basically educational in concept. Mr. Pettit stresses the need for the conservation of our natural resources by showing the relationship and dependence of plants and animals upon factors such as climate, soil, and water. The book is completed with an excellent bibliography of reference books for suggested reading.

*The Book of Nature Hobbies* will give its readers a better knowledge and deeper appreciation of how "nature works."

MARION B. CARR.

## HALFWAY TO HEAVEN

----- by Jean Hersey  
Prentice Hall, Inc., \$3.75  
259 pp., 30 illu. str.

IF you have never been "Halfway to Heaven," you will be when you read Jean Hersey's charming account of her recent travels in Guatemala by plane, bus, horse, and on foot. The title refers to the mountains where the Indians carry on their religious worship.

Here is a delightful personal adventure against the background of mythology and history, through which run the Quiché Chieftain Tecúm Uman and golden-haired Alvarado, the story of whose conquest is realistically woven into the native dances.

Humorous and informative, the book reveals the author's deep insight into the

nature of the Indians, with their material and spiritual independence. So industrious are they and so fertile the land that no one is ever hungry in Guatemala.

Customs, religious festivals, market scenes, lakes, and volcanoes are all brought vividly to life—along with a pleasurable week at a coffee *finca*, the *Baños* at Lake Atitlán, a hunt for the elusive Quetzal bird, and an unforgettable "meeting with *Mañana*."

The author's style is simple and direct, clear and sharp; and much of her charm lies in her ability to impart a vast amount of information without sounding pedantic. One cannot help but be moved by the sincerity of her writing.

Although there is much of value to the tourist, this is not a guidebook to places and things but rather an introduction to the character of a people. For all who read the story, the words of the Indian Wizard will come true, "What you seek, you will find . . . but only if there is some of it small within you in the beginning."

MRS. BARNUM BROWN.

## THE HORSE OF THE DESERT

- - - by William Robinson Brown  
The Macmillan Co., \$10.00  
218 pp., 139 illu. str.

THIS is an unrevised reprint of a book first published in 1929. Reduction to \$10.00 from \$27.50 for the first edition hardly justifies calling this a "popular-priced edition" but should make the book available to a larger number of those who love horses and the horse sports.

The Arabian horse is the aristocrat of equines and has inspired in its breeders and admirers a devotion that often exceeds reasonable bounds. Claims have been made that this is the one original breed, that all great horses have been Arabians (pedigrees and history to the contrary notwithstanding), and that all breeds from Shetland to Percheron inherit all their really good points from an Arabian strain. Such flamboyant writings make a dispassionate student approach any book on this subject with misgivings.

W. R. Brown, long president of the Arabian Horse Club of America and a leading breeder, certainly does not minimize claims for his favorites, but he keeps these within the limits of possibility. His book is, indeed, one of the most reason-

Continued on page 94

# MINERALS



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# The Book Shop

THE AMERICAN MUSEUM OF NATURAL HISTORY

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WHEN I was a boy of about twelve, I discovered that a fly could not fly if you removed one or both of its balancers or halteres (pronounced hal-TEER-eez). My discovery was not new; these tiny, knobbed, rodlike organs (one on each side of the thorax behind the wings) had been called balancers for more than 100 years. I learned of them because an older brother was required to make a collection of insects of various kinds, and he had given me the job of collecting them. Among the insects collected was a large bumblebee-like fly, and I noticed the knobbed rods. He informed me that they were called "balancers" but couldn't tell me whether they really functioned as such.

The next time I caught one of these large flies, I cut off one of the balancers with a penknife and found that the insect flew in a wide circle until it hit the ground. It was

# How Flies *FLY*

High-speed motion pictures taken at the American Museum shed light on the fly's gyroscopic organs and lead to new inferences on the mechanism of flight in some of the fastest creatures in the world

By C. H. CURRAN

*Curator, Department of Insects and Spiders,  
American Museum of Natural History*

no longer able to fly. Since then I have demonstrated many times that if one or both halteres are removed, flight is impossible. I gradually became more and more curious about the working of the halteres but realized that it would be very diffi-

cult to find out how they operated in flight.

While airplane designers had long been keenly interested in the flight of all flying creatures and had studied flies critically in order to improve their knowledge of stream-

*Courtesy Sperry Gyroscope Co.*



lining, the aerodynamics of the fly still remained a complete mystery. Great impetus was given to this study by an article that Dr. C. H. T. Townsend published in 1927 in which he estimated the speed of the Deer Bot Fly at 815 miles an hour and pointed out that at this speed the insect could fly around the world (westward) in daylight. This article resulted in a great deal of controversy, and each time the subject is renewed, hundreds of inquiries reach my office. I must say that I do not know how fast the Deer Bot travels, but I am inclined to think that it may reach half the speed estimated by Dr. Townsend.

In the autumn of 1944, Mr. R. W. Gilmor, President of the Sperry Gyroscope Company, was ushered into my office. He had a problem concerning the flight of flies, particularly the function of the halteres. His company had secured patents on an instrument that was not of the rotating or gyroscopic form but of a vibratory type, moving from side to side. He believed that further information about the action of the halteres of flies might aid in developing the invention, since these, too, were balancing or "gyroscopic" organs.

It was obvious that such a study could be made only by the use of high-speed motion pictures. All of the high-speed stroboscopic pictures I had seen failed to show clearly the movement of the wings, and the halteres were practically invisible. I had heard of Mr. Henry M. Lester as an expert in high-speed camera work and suggested that he be consulted, but by the time this could be arranged, the fly season had passed. There was little to do until the following year.

However, I had already concluded that the most satisfactory subject would be the Drone Fly, so named because it resembles a drone honeybee. It apparently had all the qualifications: it is a rela-

tively large fly, and it is capable of hovering in the air in a practically stationary position for long periods of time, which I thought it would do in a very restricted place. This I verified during the summer of 1945 at Bear Mountain, N. Y. Several captured drone flies were placed in quart jars. Every one hovered. So did most of the related species tested, but none of them were so dependable as the Drone Fly.

It was obvious that at least 100 flies would be needed for our work, but I did not capture 20 all summer. By the end of August, it began to look as though all the Drone Flies within 50 miles of New York had learned of our needs and taken off for other parts. There were occasional ones in September but still not enough, and both Mr. Lester and Mr. Gilmor were becoming very impatient. Things changed about the middle of October, and toward the end of the month hundreds of flies were available. We caught all the Drone Flies we could on the Museum windows, but these were not enough. Miss Alice Gray, of the Department of Insects and Spiders, and Miss Lucy Burbank, of the School of Public Health, Columbia University, set forth on an expedition to Central Park and Rockefeller Center, snatching every Drone Fly they could find on the flowers. Naturally, they attracted much curious attention, and many people probably thought they were crazy.

Until we began shooting, we were wholly unaware that some of the flies were temperamental prima donnas. The term is appropriate because practically all the flies caught were females. Miss Gray prepared a fly for the first shot by fastening the back of its thorax to the head of an insect pin inserted into an inverted cork. When the camera was focused, the fly's legs were freed, and it flew beautifully. The signal was given, and there was a flash of light that lasted one second while 100 feet of film raced through the camera at the rate of a mile a minute.

The result was a rather poor picture of the Drone Fly in flight, but it was much better than anything

yet produced. The second fly was a prima donna. It refused to move a muscle. Shot after shot was taken over a period of days, including a close-up of the halteres in action with one wing mostly cut off to offer a better view. Of all the shots, four were good. We thought we had done an excellent job. However, Mr. Lester was not fully satisfied. He had become fascinated with the problem, and the following summer he suggested that we repeat the program in the autumn. I agreed, and both of us gave considerable thought to improving our methods.

Apparently our summer thoughts were of little value; we did not do well the first day. But with experience, we made progress. We did learn one important thing—how to recognize the prima donnas and discard them. Unfortunately, most of the flies were in this class. We do not know the exact reason, but it seems probable that they were old and had lost the energy of youth. Many of those captured had already died, and their bodies lay in the bottom of the cage.

On the following day everything went well. Of four shots, three were as fine as could be expected. We had caught the wing motion from the front and from the side, and the movement of the halteres was enormously enlarged. From these pictures it was possible to verify our earlier results and to discover other unknown facts about the mechanics of flight. One interesting thing we found was that when the fly is at rest, the knobs at the ends of the stemlike halteres are collapsed, but when the insect starts to fly, the knobs fill with blood.

### How a Fly Flies

In the flight of a fly there are many things to study besides the mechanical movement of the wings and halteres. We possess a certain amount of knowledge of some of these things, but concerning others we know too little to draw conclusions, and of still others we are probably entirely unaware. It is too much to expect that all the secrets of flight can be solved by the study of the external organs of a fly.

\*THE TWO KNOBLIKE ORGANS are located behind and below the wings of all flies. They vibrate as rapidly as the wings and produce a balancing effect by gyroscopic action



*Photo by David B. Eisenrath, Jr.*

▲ MANY OF THE FLIES proved to be prima donnas. With film racing through the camera at a mile a minute, the Drone Fly would have been as expensive as many a Hollywood star if results had not soon been forthcoming

Internally there are muscles belonging to several categories; and there is also the nervous system, including specialized nerve cells that perform specific functions, such as those at the base of the halteres. The time may come when we find a way to observe the action of internal organs, but at present we are only able to consider them in a very general way.

The fly's wings are always the driving force that carries the insect forward, yet they are extremely varied in their efficiency. Some flies with relatively large wings, such as Crane Flies and many Pictured Wing Flies, are slow and ponderous in flight. It is therefore evident that a large wing area does not mean rapid flight; in many cases it indicates the opposite.

Almost every student of entomology has been taught that the wings of flies and bees move upward and downward in the form of a figure eight. Anyone with good eyesight

who has observed flies hovering or who has followed the flight of a bee will verify this belief. I thought I observed the figure-eight movement of the wings of both flies and bees many thousands of times. This impression, however, is wrong. The wings move so fast that an optical illusion is produced, and this is clearly demonstrated in the high-speed pictures of the Drone Fly.

The pictures show that as the wings move up and down, there is a definite swiveling action, so that the strongly reinforced costa (the front edge) is carried upward or downward in advance of the fine, membranous hind border. The wings are therefore tipped at an angle of about 45 degrees from the horizontal during each stroke. There is no apparent difference in the driving power of the upward and downward strokes.

Another important thing the pictures disclosed is that the driving power of the wing is greatly in-

creased by its flexibility. As the wing begins its downward stroke, the membrane, which has been moving upward at an angle of 45°, now comes in strong contact with air pressure, causing the center of the wing to "balloon" slightly upward while its hind edge is still curved in the other direction from the previous upward stroke. The reverse is true when the upward stroke begins. The wing membrane is never a flat surface but billows upward on the downstroke and downward on the upstroke. But the bulge is not so pronounced as in a sail filled with wind, because the middle part of the wing is reinforced with veins while the hind border is quite fragile.

While this situation is found in the Drone Fly and all other rapid fliers and hoverers, it is only weakly developed in the slow fliers. Nevertheless, it is sufficiently developed in all flies to enable them to fly in a straight line. We know that the wingbeat of the slow fliers is much slower than that of the fast fliers, but we do not have pictures to show us what the difference is. The wingbeat of most Crane Flies is probably under 100 per second, and in the House Fly it is approximately 180 at top speed. The various kinds of mosquitoes undoubtedly have different wing speeds, but none of them probably reach the wing speed of the House Fly. The rapidity of wing movement is important in developing driving power, but other factors are also very important. Some of these are:

1. Flexibility of wing. The best fliers have wings that are heavy in front and weak behind. Poor fliers do not show this marked difference. It is therefore apparent that rapid flight is obtained by the "billowing" of the wing membrane.

2. Shape of wing. The best fliers have long, somewhat pointed wings, but so do some of the poorer ones. Long wings are not essential. Some of the fast Syrphids have broad wings, and so do the Bot Flies and some of the fastest Horse Flies.

3. Weight of body. The Bot Flies and Horse Flies are heavy-bodied creatures, and because of this we might conclude that a heavy body

is essential to rapid flight. Such a hypothesis is not supported by the facts. Many of the Hover Flies are light-bodied but can apparently fly as fast as any of their heavy-bodied relatives, at least for short distances. One moment they are "hanging motionless in the air," the next they are six or eight feet away. They move so fast that you cannot follow their flight; you only see the accomplished fact. On the other hand, midges, mosquitoes, and many other flies with relatively light bodies are poorer fliers. So are the Crane Flies, but these are handicapped by long, gangling legs.

4. Shape of thorax. A wide and deep thorax (the part of the body bearing the wings and legs) is essential to rapid flight. The muscles of the thorax furnish the dynamic power that drives the wings and rotates them at the end of each stroke. All fast-flying flies have a heavy chest. There are no speedy ones with a long or narrow thorax.

5. Size of head. The fastest fliers all have large heads, except the Horse Flies, which have a broad but short head. The conclusion is that the head gives increased weight and produces balance.

6. Speed of wing stroke. In order to achieve rapid flight, the wings must move rapidly.

These are the obvious factors influencing the propulsion of insects at high speed. It would seem a simple matter to devise a mathematical formula that would show at a glance the factors entering into rapid flight. There are certainly four essential things: flexibility of wing, rapidity of wing stroke, weight of body, and direction of wing stroke.

The first three are an inseparable combination. It is to be noted that wing area does not enter into the compilation although, strange as it may seem, relatively small wing area in comparison to body weight is apparently necessary for high speed.

### Comparing Flight

Examination of the flight of the Hummingbird in pictures taken at 3000 frames per second enables us to compare this with the flight of the Drone Fly. Although the Hum-

► THE PICTURES showed that the fly swivels its wings at the beginning of each upward and downward stroke. Thus the heavier forward edge of the wing leads at an angle of about 45 degrees, with the more flexible portion following and billowing outward

*Photos by Henry M. Lester*

mingbird's wings move at only about 80 beats per second, as compared with 300 for the Drone Fly, the wing action is remarkably similar in many respects. In the Hummingbird the flexibility of the wing feathers provides a similar "billowing" action, and the front edge of the wing is heavy, the hind edge delicate as in the fast flies.

The Hummingbird turns by spreading the feathers toward the tip of one wing. This permits the air to pass through and causes a relative increase in the air pressure on the other wing. In the fly, turning is accomplished by "feathering" one wing. The fly greatly reduces the speed of the wing in the direction in which it is going to turn.

Steering is different, yet the principles are the same. The fly uses its hind legs as a rudder. If the wind comes from the right of the fly, the left hind leg is dragged toward the left while the right one is neatly folded against the body. The halteres also play a part in this since they help the insect to "bank on the curve." The Hummingbird uses its tail to steer. When it backs up, the tail is thrown forward in a triangle with its apex behind, thus reducing air pressure to a minimum. When stationary, the tail is broadened to full width to produce balance; and when moving forward, the tail is again a V but with the angle now in front.

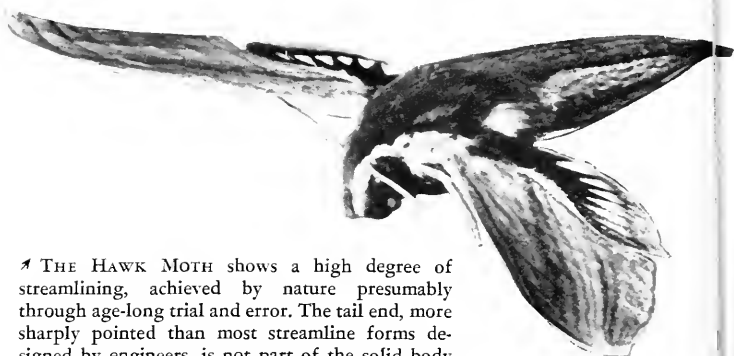
The flight of butterflies and moths is generally slow and cumbersome. In most of them the wing surface is quite large, and the front and hind wings are hooked together during flight. Their relatively large wing expanse and the light weight of their body naturally produce an undulating motion. This undulating flight is not a disadvantage; it un-



doubtedly protects the flier from natural enemies, such as bats, birds, and predaceous insects. However, there are some moths that are extremely fast fliers.

No one has any idea of how fast the Hawk Moths can fly, but it seems probable that some of them are almost as speedy as the fastest flies. They are sometimes known as Hummingbird Moths because of their habit of hovering before flowers and sucking the nectar by means of their long tubular mouthparts. They are among the few kinds of animals that can fly backwards. My list of backward fliers also includes the Hummingbirds, Sunbirds (to some extent), some large tropical Damsel Flies that pick spiders from their webs, and some of the Bee Flies, which are true flies with feeding habits similar to the Hawk Moths.

The fastest of the Hawk Moths conform perfectly to man's idea of streamlining. The head and thorax have all the qualities of weight and ruggedness that seem so essential for rapid flight in the insect world, and the body tapers gracefully to a narrow point. The wings, too, are perfectly designed for rapid flight. They are long and narrow, more or less pointed, and very strong in front; actually, they are so shaped that they must function in the same way as the wings of a fly. The streamlining of the Hawk Moths provides an ideal that students of aerodynamics have long desired to attain. However, no plane approaches this in streamline per-



AMNH photo

▲ THE HAWK MOTH shows a high degree of streamlining, achieved by nature presumably through age-long trial and error. The tail end, more sharply pointed than most streamline forms designed by engineers, is not part of the solid body of the insect but is loosely made up of hairs

fection, perhaps because perfect streamlining does not produce best results in conjunction with rigid wings. Nature's streamlining is the result of millions of years of experimentation, and it may produce optimum results in eliminating air resistance and vacuum drag only in a flying mechanism with movable wings.

The flight of the Honeybee has long been a matter of curiosity, quite naturally, because this bee has been associated with man for untold ages as the producer of one of our richest foods. The Honeybee flies exactly like the Drone Fly, except that it lacks halteres and presumably depends upon wing motion and the use of its legs to provide natural balance. In flight the front and hind wings of the Honeybee and other Hymenoptera are locked together by a series of

hooks on the front of the hind wing. These hold the front margin of the hind wings tightly in place so that both wings function as a single pair, as do those of butterflies.

As a general rule, insects with two pairs of wings that are neither hooked together nor shaped in such a way as to function as a single pair are poor fliers; but there is one notable exception. This is the Dragonfly, which is closely related to the Damsel Flies. Like the heavy-bodied flies and Hawk Moths, the Dragonflies are ideally adapted for rapid flight. They have a large head and thorax and a slender or flattened abdomen. In the most rapid Dragonflies the abdomen is cylindrical or nearly so, but it is not streamlined as in the Hawk Moths and some flies. As yet, we have no proof of the way in which the wings of the Dragonfly function, but there

SPEED AND MANEUVERABILITY distinguish the flight of the Hawk Moth. It can fly backwards



THE BOT FLY is believed to be the most rapid flier in nature and may travel at more than 400 miles an hour. It has a stubby, well-rounded body and strongly powered wings



THE DRAGON FLY is no fly, so it lacks the balancing organs; but it is a strong, swift flier. Its fore and hind wings apparently move in opposition



is every reason to believe that when we obtain high-speed motion pictures of this insect in flight, they will show that the front and hind wings work in opposition; in other words, the front wing moves upward when the hind wing moves downward. This might be compared in some ways to the use of propellers that turn in opposite directions on an airplane, in the latter case to reduce torque, or corkscrew, effect. It is thought that the wings of the Dragonfly move slower than those of the Drone Fly and that a motion picture taken at 2000 frames a second may produce extremely slow motion. At the same time, it seems possible that the number of wingbeats per second may equal that of the fly, but the angle of the wing surface in up-and-down motion may be less than 45°, and the distance the wings travel may also be much less.

The poorest flight found among insects is in the Hepialid moths and the adults of Ant Lions and some related forms. These insects are of special interest because they resemble a helicopter in flight. In both the Hepialids and Ant Lions there seems to be no co-ordination between the movement of the front and hind wings. They seem to go "every which way," and the direction of flight seems uncertain. I have watched hundreds of adult Ant Lions flutter into a circle of light and lumber around until they found a suitable landing place. Each time, I was reminded of a

helicopter, and other bystanders have often made the same comparison. I believe that the Ant Lion works on the same principle as the helicopter, whose wings rotate slowly to maintain altitude and carry the craft forward.

### The Halteres

These are definitely balancing organs, but there is very much that we do not know about them. It is difficult to imagine how they can be moved at such high speed with such a small amount of muscular tissue attached to their base. We find that the front and hind edges of the base are produced as a short arm and that each fits into a socket. The main stem of the halter is produced somewhat below the two arms; and muscles are attached both to the upper and lower sides of the produced stem and to the lower part of the main stem. Some of these muscles are so fine and so intricately interwoven with other muscular tissue that their presence has not yet been reported in scientific journals, but they have been discovered by a student at Cornell University. It seems probable that additional muscles will be discovered when morphological technique is perfected.

There are extensive areas that are at least partly sensory in function at the base of each halter and in the membrane that joins them to the body wall. Those in the membrane are rather lattice-like in shape, and it is possible that this

lattice-like structure produces an elastic effect through pressure and stretching which may greatly reduce the amount of muscular power needed to vibrate the halteres at high speed.

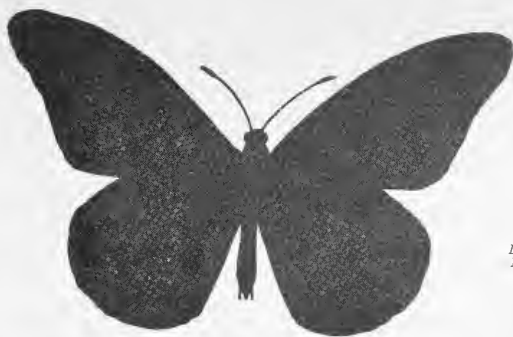
So perfectly is the movement of the halteres co-ordinated with that of the wings during rapid flight that we can assume that the stimuli activating both are received at the same time and from the same source. However, the pictures show that the halteres may continue to move for an extremely short time after wing movement has ceased. One might suppose that they were just "dying down" more slowly, owing to their momentum and the flexibility of their attachment to the body. But sometimes the fly stops them abruptly, so they must be said to have some independent action, which may help the fly to adjust itself to its new surroundings at the time it comes to rest. External stimuli are received from three sources—the antennae, the eyes, and from the feet through vibration. These stimuli are transferred instantly through an extremely primitive nervous system, and the halteres begin to function as soon as the wings do. Much additional study will be necessary in order to determine exactly how all this is accomplished.

Almost everyone is familiar with the way a toy gyroscope resists being turned and how it will hang at right angles when suspended from a string. The gyroscope's

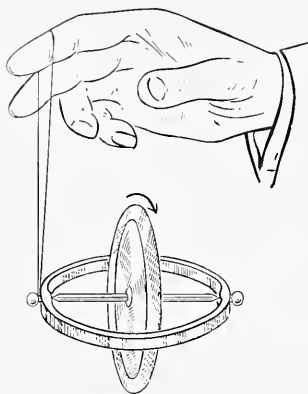


THE ADULT ANT LION is a slow and poorly powered flier, but it can hover like a helicopter

BUTTERFLIES are slow and erratic, yet some of them migrate thousands of miles



THE HOVER FLY has great speed for several yards or so but has no endurance



▲ WHEN A SPINNING GYROSCOPE is hung from a string as shown here, it will hold this position against the force of gravity. It is this property of "rigidity in space" that makes it useful in navigation

"rigidity in space" is what makes it useful as a navigating instrument in planes and ships.

This tendency of the gyroscope to remain in a fixed position is utilized in two ways—as a stabilizer and for purposes similar to those of a compass. If a very large and heavy gyroscope is mounted immovably in a ship, the ship becomes part of the gyroscope and takes on its quality of rigidity in space. The ship will move in a straight line just as though it carried no gyroscope, but with the instrument it resists the rolling action of waves. If a smaller and more delicate gyroscope is mounted so that it "floats" freely, it maintains its "compass direction," regardless of how the ship turns. Such an instrument is now standard equipment in all large ships and planes in place of the magnetic compass. It is usually connected with the steering apparatus so that the unit becomes an "automatic pilot." This enables the ship or plane to go in a specific direction without anyone at the controls.

The balancing organs of the fly are like a stabilizing gyroscope except that the little weights vibrate back and forth, whereas in the gyroscope the weight is distributed around the rim of a spinning

wheel. Otherwise the principle, and the effect, are the same.

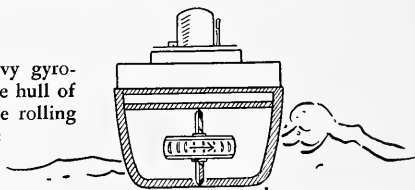
We naturally wonder whether the halteres of the fly act as a stabilizer or as an organ of direction. Do they simply prevent the fly from being buffeted about and turned upside down in flight by their purely mechanical effect? This effect would be produced even if there were no connection between the halteres and the fly's nervous system. You could fix a tiny mechanical gyroscope to the fly's back and get the same result. Whether the halteres move fast enough and are heavy enough in comparison with the fly's body to function in this purely mechanical way might be computed mathematically, but we have not done this yet.

Or are they used as compasses that telegraph messages through the fly's nervous system every time

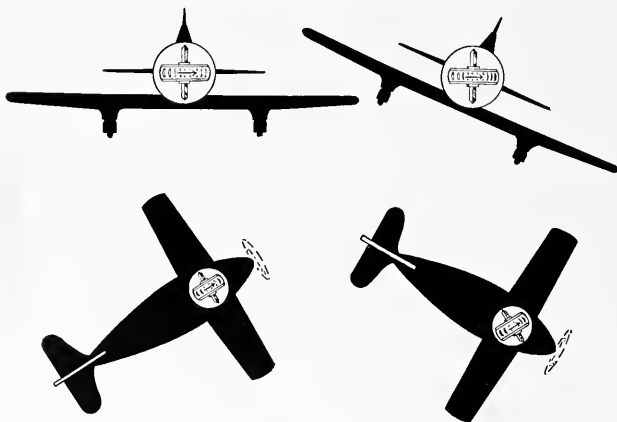
it changes the direction of its flight? In this case, the force with which they resisted the change of direction would indicate to the fly the sharpness of the turn. In the first instance, making a turn would be somewhat like going up a hill. The insect would have to work harder to fly in a curve (steering, of course, at the same time), because it would be working against the resistance of the gyroscope as well as against the inertia of its own body. In the second instance, the gyroscopic force of the halteres might be much weaker yet still perceptible to the fly through delicate nerves in or around the base of the halteres. The difference is an important one because the second type of instrument would be a much more sensitive and intricate apparatus. It would represent a specialization of the fly's nervous system of no small complexity and one of which we

#### GYROSCOPES ARE USED IN TWO WAYS

► If a strong, heavy gyroscope is fixed to the hull of a ship, it resists the rolling action of the waves

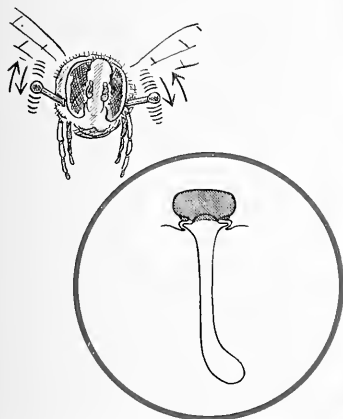


▼ When a gyroscope is set to point in a certain direction and allowed freedom of motion in its mounting, it will hold its direction although the plane follows a crooked course



*Drawings by Museum Illustrators' Corps*

► **PHOTOGRAPH** of a living fly showing location of balancing organs. They can be seen by the naked eye on any House Fly



▲ **THE KNOBBED RODS** of the fly's balancing equipment do not spin like a gyroscope; they only vibrate. But they do take on the same "rigidity in space." The elastic effect of lattice-like tissue near the base may facilitate their very rapid vibration

ourselves can boast no exact counterpart.

This leads to the fascinating question of how the fly ever developed these organs. The older view was to assume that all creatures were created with the equipment they now possess. Modern evolutionary theory, however, holds that the various organs have developed gradually. Any organ that was valuable to an animal went through continuous improvement through the ages. The fishes' fins in time became feet and legs, serviceable to reptiles on land. The forearms of the bat have become wings, and so forth. Students of paleontology (the science of prehistoric animal life as revealed through fossilized remains) can trace all or nearly all of the intermediate stages in these developments. A poor foot is better than no foot at all to an animal living on land. And at first a webbed forearm and hand probably only helped the bat to glide from branch to branch, not to fly. Only through



*Photo by Henry M. Lester*

further development of the organs for flying and the muscles controlling these organs did the bats become real fliers. The test of a developing organ throughout, according to the theory of evolution, is its survival value, and most of the organs had utility even in their earliest forms.

How does this affect our reasoning about the origin of the halteres? It causes us to ask how the earliest and simplest halteres could have benefited the fly, because in order to produce an appreciable gyroscopic effect, they must vibrate very rapidly, and rapid vibration presupposes a certain degree of mechanical perfection. This question is full of far-reaching philosophical implications, and it can only be answered when we have more knowledge than we now possess. Suffice it to say that one more or less obvious explanation presents itself. This is that the halteres did not start as halteres but developed from other organs whose purpose was originally quite different—organs already capable of rapid movement. It has generally been supposed that the halteres developed from a second pair of wings, but there is considerable evidence to discount this theory.

In all flies there is an organ called the squama, or calypter. This organ lies a little below and behind the wings, and it is always connected with the wings by a much narrower membrane. The squamae are situated exactly where the second pair of wings would naturally occur. They are not found in four-winged insects, but like the wings of almost all flies (and many other insects), they are fringed with hairs. Such a condition might be expected in any modification of a second pair of wings.

The halteres are situated far below and behind the attachment of the wings. Indeed, their location precludes the possibility of their ever having been wings unless one accepts the principle of the migration of functional organs from one part of the body to another. But let us side-step this controversial issue by pointing out that the development of a stabilizing organ is at the present time probably taking place in an unrelated group of insects, the Strepsiptera. These insects, closely related to the beetles, are developing sensory, bulging organs in front of the wings that might eventually develop into balancers. As yet, they are merely knobs, but in a few million years they might

*Continued on page 95*

# The Watch that LINCOLN Gave

A little-known story from the life of the Great Emancipator, which takes the reader to the far-away isles of the Pacific and to the plight of an American seaman who was about to be killed and eaten

By WILMON MENARD

IN 1931, when I was planning to visit the island of Hiva Oa in the Marquesas Group, I was told that on going ashore to the palm tree beach, I might be stopped by a short, white-haired native with a kindly face who would try to sell me a watch. "Don't just shake your head and hurry on," I was advised. "If you do, you will miss a remarkable story."

It happened almost exactly as predicted. The barefooted man in the white drill suit was Samuel Kekela; and his wife was with him. Samuel Kekela was the son of James Kekela, the founder of the largest mission station at Puamau, Hiva Oa. When the elder Kekela died, his son Samuel inherited this large gold watch, which had been sent to his father in 1864 by none other than Abraham Lincoln. The watch was an expression of Lincoln's thanks to Kekela for his part in saving the life of an American seaman who was about to be eaten by cannibals at Puamau.

It happened in this way. The wild cannibal tribes of Puamau had long nursed a hatred for the white sailors, a thirst for vengeance which had started when a Peruvian whaling ship sailed into the bay, firing upon the defenseless villages, ravishing the native girls, and carrying off men to work in the mines of Peru. The Puamau tribes took a pledge then and there to eat the next white sailor found ashore.



Wilmon Menard photo

▲ SAMUEL KEKELA, son of the missionary to whom Lincoln gave the watch

One day the first mate of an American whaler, having heard of the astonishing beauty of the native girls, came ashore in Puamau. With promises of a prize beauty of their tribe, the bland-faced native men enticed the unsuspecting sailor farther up the valley, away from the mission station. He went gaily and willingly, his arms locked in those of the cannibals. Then the natives leaped upon him, tied him

up, and threw him between the roots of a large tree which over-shadowed a *paepae*, or stone altar. Faggots and logs were gathered for the roasting, while the natives called together other members of their tribe for the big feast. The victim was Jonathan Whalon, mate of the whaling ship "Congress," commanded by Captain Stranburg.

James Kekela had been away from Puamau when the ship arrived. According to his own account, when he returned many people told him, "A certain white man is about to be roasted."

"Who is doing it?" Kekela asked.

He was informed that the leader was a chief named Mato, whose son had been kidnapped by Spanish seamen.

Kekela secured additional information from his Hawaiian associate, Rev. Alexander Kaukau, who had tried to dissuade the chief from killing the white man. But Mato, recalling the kidnapping of his son, only answered, "They are all one kind, white men. This is all I have to say to you, Kaukau, whether the captain gives me a new boat or not, I shall roast this white man."

But this did not discourage Kekela. He sent an emissary to Mato offering his own boat and anything else the chief wanted in exchange for the life of the sailor. Then, the next morning, he dressed himself in his Sunday clothes and, accompanied by Kaukau, rushed up the valley with only the Bible in his hand. When they arrived, Mato and his men were ready to start cooking the white man. Kekela strode past the glowering natives, knelt over the terrified victim, and prayed for him. He then met with Mato and talked with him. The chief of the cannibals was no doubt impressed with Kekela's composure and sartorial distinction. Some sort of transaction appeared possible. At this point, another friend of Kekela's stepped forward with a gun and offered it to the chief. This gesture, added to the impression Kekela had already made and the gifts he had promised, convinced the chief, and Jonathan Whalon was spared. Kekela at once led him to his house where the seaman would be safe from the young warriors, should they attempt to recapture him.

The dramatic circumstances of Jonathan Whalon's capture and rescue were reported when his ship reached America, and the incident eventually came to the attention of President Abraham Lincoln. Although the President was engrossed in the war between the States, he was so moved that he sent \$500 in gold to Dr. McBride, U. S. Minister resident in Honolulu, for the purchase of suitable gifts that would express his gratitude to those who had participated in the rescue. Most interesting among these gifts is the large gold watch that is shown here, and it is still in existence. The inscription on it is translated from Hawaiian as follows:

From the  
President of the United States  
to  
Rev. J. Kekela  
For His Noble Conduct in Rescuing  
An American Citizen from Death  
on the Island of Hiva Oa  
January 14, 1864

A similar watch is said to have been given to Kaukau, Kekela's associate in the rescue, but the writer does not know its whereabouts. Various other presents were given, but they also seem to have become scattered during the many years that have passed since the occurrence of this interesting but little-known event.

Kekela acknowledged receipt of his gift in a personal letter to the President of the United States. "We have received your gifts of friendship," he wrote. "... Ah! I greatly honor your interest in this countryman of yours. It is, indeed, in keeping with all I have known of your acts as President of the United States..." Kekela signed the letter: "I am, Abraham Lincoln, President of the United States, your ob't. serv't., James Kekela."

When Robert Louis Stevenson, who was not without bias against Protestant missionary efforts in the South Seas, saw this letter, he was moved to say, "I do not envy the man who can read it without emotion."

I first saw this watch in 1931, during a visit to the Marquesas, when it was offered to me for purchase. I saw it again in 1933 at Hiva Oa, when a friend of Kekela's

attempted to sell it aboard the schooner I was on; he explained that Kekela was in bed with rheumatism. The watchcase was marred a little where, as Kekela had explained to me, his father had banged it vehemently on the pulpit as he exhorted his cannibal parishioners to change their diet from *puaka enata* ("long-pig") to just plain pig.

I was often sorry that I had not been able to buy the watch. Surely I could have placed it in the hands of some wealthy collector of old and famous timepieces. But now it has found its proper home. It has become the property of the Hawaiian Mission Children's Society in Honolulu; and when the dream of a historical museum for Honolulu materializes, it is hoped that this historic treasure will be placed there on permanent exhibition.

Many changes have come to the Islands since the elder Kekela hammered the pulpit with his famous watch. But for those who would otherwise forget what the Islands were like less than a century ago, James Kekela's memorial tablet bears this inscription as a reminder: "... in 1864 he was signally rewarded by Abraham Lincoln for rescuing an American seaman from cannibals."

▼ THE HISTORIC TIMEPIECE as it appears today, bearing Abraham Lincoln's inscription to Rev. J. Kekela "for his noble conduct in rescuing an American seaman from death. . . ."



Courtesy Hawaiian Mission Children's Society

◀ A SCENE IN CANYON DEL MUERTO, the picturesque gorge in the heart of the Navajo country where the Weaver dwelt more than six centuries ago

WE found the "mummy" near the close of what had been, up to that moment, a most disagreeable day. Everything we had turned our hands to had gone wrong. By four in the afternoon we had accomplished what should have been done by eight in the morning. One of our three cars, which we had been able to tinker into running order, was at last out of hearing on its 100-mile journey to Gallup, New Mexico, to replenish our food supply and bring back replacements for the broken parts of the other two cars. Hours of minor frustrations, piling one on top of the other, had worn our nerves raw, our tempers thin.

Oscar, the silent and indefatigable, my stand-by in any situation, said, "Earl, I'm going to dig a while. If I don't get rid of some steam, I'll bite somebody's head off before bedtime." He caught up a shovel and started away; I did not notice in which direction.

The five of us were an archaeological expedition, encamped in Canyon del Muerto. Canyon del Muerto is a mighty gorge, cut deep into a red sandstone plateau in northeastern Arizona. Crooked as the path of a snake throughout the many miles of its length, its sheer walls are pitted with shallow caves. These caves provided shelter from

## TOMB OF THE *Weaver*

The story of a stirring discovery in Arizona's "Canyon of the Dead" and how the clues it gave fitted into the pattern of prehistoric Indian life in the Southwest

By EARL H. MORRIS\*

\*BORN IN NEW MEXICO, Earl Morris unearthed his first prehistoric pottery vessel at the age of four. Before graduating from the University of Colorado, he had been on several expeditions to the Southwest and Central America. For the American Museum of Natural History, he directed the development of the Aztec Ruin National Monument, New Mexico, from 1916 to 1923. And between 1924 and 1929, he excavated and repaired the Temple of the Warriors at Chichen Itzá, Yucatán, for the Carnegie Institution of Washington. As Senior Archaeologist for the Carnegie Institution, he is again at work on the Basket Maker-Pueblo culture area of the Southwest.—Ed.

the elements and protection from enemies for the Indians who dwelt in the recesses of the Canyon from near the beginning of the Christian Era until about the year 1300. And even today, the Navajo, in the heart of whose reservation the Canyon lies, raise their corn and peaches on its bottom land and graze their sheep upon its talus slopes. The purpose of our excavations was to learn all we could about the manner of living and the history of the pre-Navajo inhabitants of the great red gorge.

It was my duty to record the events of the days as they passed, so I sat down at the coffee-box table to account somehow for the current one, which it would have been a pleasure to forget. The pencil had accomplished but a line or two when a shout brought me to my feet. The second time it came, I caught the direction. There, straight across the canyon from me, stood Oscar at the top of the talus beside the face of a thin promontory of cliff that juts north toward Antelope House. The acoustic properties of the great curving wall of rock behind me could well be the envy of any architect. Though nearly a quarter of a mile away, and speaking in a voice scarcely raised, Oscar's words came to me as plainly as if he were at my side.

"Bring a flashlight and come over."

"What have you found?"

"Dunno. That's why I want the light."

I grabbed one out of a duffel bag and was off across the sand flat that was a stream bed in times of flood, through the shallow, ten-yard trickle to which the stream had then subsided, and up the talus beyond.

When I arrived, out of breath, where Oscar stood, he silently led the way to the spot where he had scraped back from the foot of the cliff not more than a bushel of sand.

#### **Protected from Rain**

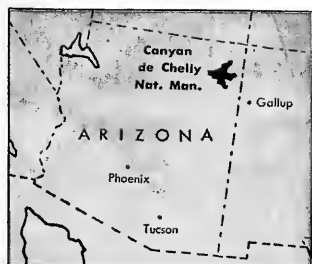
We were in a long, shallow cave or, better, rock shelter, which was incredibly dry because the rim of the cliff leaned out so far that no drop of rain could reach a strip of varying width along the back wall. In ground plan the dry area might be likened to a carpenter's square laid flat, the tongue pointing to the east, the blade to the north. Into the tongue portion the sun never shone, even in summer. Apparently sunshine made no difference to the earliest aborigines thus far known to have dwelt in this region. For long they had camped, buried their dead, and cached their seed corn and other valuables in the shaded portion. Centuries later, descendants of the original colonists had cluttered the blade part with their masonry houses, where the sun does strike until about noon.

We had dug the tongue from one end to the other, because at the time we were engaged in a study of the earlier culture stages in Canyon del Muerto. Already we had learned disproportionately much about remains from the later periods, and so we had left the blade portion alone. It was about midway of the length of this that Oscar had scraped aside his bushel of sand to uncover a thick layer of stringy bark of the Utah juniper. He had pulled aside some of the bark to reveal a crisscross of willow stems, and where he had pried some of these apart, empty blackness showed beneath.

I thrust my face as far as I could into the opening, cast a beam of light into the darkness, and was staring into a D-shaped crypt, the curve a wall of masonry, the straight part the face of the native cliff. So carefully had the roof been constructed that, though centuries had passed, no dust or sand had trickled through. Across the bottom of the cavity lay a dark mass which I knew at a glance to be the burial bundle of a full-grown person. The

▼ THE TOMB was discovered at the foot of the cliff below the rocks just visible in the foreground. The author's camp is indicated by the black rectangle. This picture was taken by Charles A. Lindbergh later the same season

*Photo by Charles A. Lindbergh*





visible wrapping appeared to be either a bear or buffalo hide with rather curly brown hair. For binding cords, the bundle was encircled in every direction with thick hanks of fine cord, white as if from new-spun cotton. Between the bundle and the cliff were stacks of baskets and pottery vessels. Pots, baskets, bundle were all tantalizingly beyond arm's reach. It was now past sundown and hence too dark for pictures to be taken. All we could do was to cover the peephole carefully with a flat stone and wait until the morrow to examine what was, beyond question, a phenomenal find.

We hit the bedrolls early. When the lantern winked out, the darkness down in the depths of the

canyon closed about us as if we were at the bottom of a well—darkness so palpable that one breathed deeply as if to counteract its weight. Silence, comparably intense, seemed only deepened by occasional interruptions. Once an owl hooted, and once a pebble, loosened from the rimrock 600 feet above, whistled as it clove the air and struck with an ominous thud in the sand just beyond our bedding place. One belated Navajo rider passed, singing to fend off the demons of the night a chant so shrill and eerie that the diabolical laughter of a far-off coyote seemed but an answer to his song.

#### How Old?

One misgiving was slow in being

crowded from my mind. The burial bundle was so wonderfully preserved and the binding cords so new looking that I suspected we might have come upon the body of a Navajo interred within the last century or so. But the pottery vessels in the pit were undeniably of ancient make. It would be without precedent to find handiwork of an older people laid away with a representative of a more recent tribe and time. Surely, despite its freshness of appearance, the shroud concealed what was mortal of an American entombed before Columbus had been born. Long I speculated as to the sex, age at death, and probable appearance of the withered form that within a few hours we were to behold. Black lay the ragged lines of the canyon rim against a star-flecked vault, their gnarled spires tortured by eons of wind and rain and sun and frost into contours so fantastic that among them might be found resemblance to anything imagination might devise. That ancient brain, quiet and shrunken in its case of bone! What forms, real or mythical, had it discerned on those nights of long ago when it had stared through eyes as widely open and as sentient as my own at these same phantasmal silhouettes?

Sunrise found us beside the crypt. One by one we removed the several elements of the cover, recording every significant feature in both notes and photographs. First, there



▲ AFTER REMOVAL of sand, stones, and juniper bark, a plaited mat covered the Weaver's tomb

➤ THE DARK BUNDLE containing the body of the Weaver is here visible beneath the skeins of white yarn, the broken bow, and the digging stick. At upper left are baskets and pottery vessels





◀ THE WEAVER surrounded by the contents of his tomb—implements buried with him for use in the afterworld

▼ ALTHOUGH not embalmed, the body was preserved for more than six centuries as a natural "mummy" because of the dryness of the region. Pressure of the cotton blanket textured the face to resemble reptile skin

was a foot or so of loose white sand that had formed the visible portion of the cave floor. Half buried in it was the corned-beef tin I had tossed aside during a lunch hour spent on the very spot seven summers before. Under the sand was an intermittent layer of stone slabs, placed to press together the vast tangle of juniper bark that had done most to give the tomb an almost hermetic seal. The bark lay on something unnoticed the previous evening—a mat beautifully plaited from rush stems, four feet one way by five the other. Beneath the mat, the willow stems, packed tightly together like the closed fingers of one's hand, were in two layers, one at a right angle to the other. With its tip thrust upward into the lower layer was a spindle whorl—a disk of wood on a reed-stem axle. Five stout poles, equally spaced across the pit, had been the support for the entire cover. They were as white and clean as if newly peeled, despite the fact that the extremities and knots showed plainly the result of haggling blows struck by a stone ax before there was a blade of steel in the Western Hemisphere.

Now we could reach down and



touch the shroud. It was not hide of bear or buffalo but a feather blanket, different from the many we had seen before, and more handsome. Its color, a rich, dark brown, was in pronounced contrast to the mottled gray of the turkey feathers which the old people had customarily used for blanket making. The down was so long and so closely packed that ladies who have since seen it have compared the texture of the fabric to marabou. None of us could suggest a local bird capable of providing such plumage. By feeling the bundle with fingertips, we soon determined that arms and legs were tightly folded in front of the torso and that the body lay on the left side with the head to the south. There was a billet of wood for a pillow.

#### **Highly Respected**

The very quality of the robe indicated that the person inside had been someone of more than ordinary rank. This assumption was amply confirmed by the wealth and variety of the objects laid away as a provision against every need that grieving friends and kinsmen could foresee in whatever spirit land they believed to exist beyond the grave. Diagonally across the bundle lay most of a very long digging stick of hard wood, a tool that had served as plow, shovel, hoe, and cultivator. Beside it, comparable in length, was a bow so thick and stout that only a powerful arm could have drawn it. Because digging stick and bow had been too long to fit into the pit, they had been broken. However, that had not lessened their value, for it was not their material form but their spirit essence that was to serve the spirit of their owner. The blade of the stick and the tip of the bow that bore the bow cord of twisted sinew had been tucked down beside and partly under the bundle. With these was a single arrow, the shaft constructed of reed stem and the tip of hard wood made harder still by toasting in a fire.

Covering the stacks of utensils were large sections of an almost spherical water jar of several gallons capacity. A careless or trembling

hand had dropped and broken it beside the pit, and only the larger fragments had been gathered up and placed inside. Later we found the smaller pieces by sifting the sand around the spot where the accident had occurred. An intricate pattern in black covered the pearly-gray vessel from neck to midbody to handles. Among the utensils covered by the jar fragments were three pottery bowls, also black-on-gray; a vessel, deep red in color, with a small opening in its flattened top and a design in vivid black; four bowl-shaped baskets plaited from yucca leaves; and another basket of the same shape done in the coiling technique. In these containers had been placed the food-stuffs provided for the dead—corn meal, shelled corn, four ears of husked corn, nuts from the piñon pine, brown beans, and, lastly, salt. Except for squash and none-too-frequent meat, these represented practically the full range of the Old People's diet. The bundle and its accompaniments lay over the sandy bottom of the crypt on a rush mat like the one in the roof, except that the straw-brown ground color was crossed by stripes of black.

#### **The Cotton Yarn**

After the entire contents of the grave had been moved across canyon to our tentless camp, where the outward-leaning cliff gave shelter from everything but wind, we spent hours in mending the large water jar and in detailed examination of the objects found with the burial. The thick skeins of cotton yarn that formed a veritable maze around the bundle struck us all with wonder. A single stout cord would have accomplished the same purpose. Plainly, the yarn had been intended primarily as a burial offering. It was of two sizes, and there was no mixing of the two. Each skein contained either coarse or fine strands. Ann spent a long time tracing with her tape the length of the skeins through their many knots and twistings. She counted the strands in each, then set to work with a pencil. Finally she looked up from a well-filled sheet of paper.

"Guess how far those cords would reach if they were laid out end to end?"

We offered our estimates.

"Way short, all of you. The total is a little over two miles!"

Weeks, months, perhaps even years, would have been consumed in the making of such a length of yarn with no tools except deft fingers and a primitive spindle whorl.

#### **The Weaver's Face**

The bundle itself was a source of conflict in my mind. It was so perfectly preserved that I felt it should be kept for a museum exhibit, undisturbed in every detail. Yet the urge to view the contents was more than I could long withstand. The result was a compromise; we would uncover the head and leave the rest as it was.

It took but a moment to push aside two or three twists of the binding cords and to fold back the edges of the feather shroud. Inside was a fine-textured cotton blanket, white and clean as if just from the loom, done in an over-under weave with the same edge finish used by Navajo weavers of the present day. Under it was another of the same sort but gray and grimy from long use. When its folds were laid back, one instinctively recoiled from the grisly sight it had concealed.

The head was that of an old man, unusually tall for his people. The shrunken face was extremely long and proportionately wide, the effect accentuated by the breadth of the skull, which in infancy had been pushed out at the sides by tight binding on a cradleboard. Coarse black hair, faintly streaked with gray, hung loosely over the forehead, and from the back it was folded upon itself into a thick bob and tied with a spiral wrapping of cord below the nape of the neck. A few hairs drooped from each extremity of the upper lip, and on the chin was a short and very scanty beard. The flesh, preserved by no other agency than desiccation, had settled back against the bone to give the effect of a hideous leathern mask, textured by pressure of the blanket to resemble reptile skin. Tightness of the wrappings

had bent the nose upward and to the left and had jammed the lower lip against the nether surface of the slightly protruding tongue. Whether this grimace was the result of posthumous accident or whether the old man died in a paroxysm of pain is a matter for conjecture; but there is no denying the ghastly effect it contributed to a face that, although strong and dignified, had not been handsome in the first place.

As far as I know, this natural "mummy" has not been further unwrapped, but my bared arm, thrust under the shroud and between the inner blanket and the still greasy skin, added a few further details to our notes. The knees were drawn up by the left side of the chest so that the heels almost touched the buttocks. The upper arms were straight by the sides, the forearms bent upward with hands crossed just below the throat. In this position the wrists were tied, first with a cotton rag and then with a twist of soft buckskin. Over the breast, between the two cotton blankets, was a single ear of corn.

### **The Feather Robe**

Long we debated as to the identity of the feathers composing the visible part of the outer wrapping of the body. Answer to that question did not come until the following winter, when the "mummy" and its accoutrements were on display at an Annual Exhibition of Carnegie Institution in Washington, D. C. On the evening of the reception, Dr. Alexander Wetmore gazed long at the handsome robe and then said:

"If you'll get me a wisp of those feathers from some place that won't show, I'll find out what bird they came from."

When opportunity arose, I removed from the underside of the bundle what seemed an adequate sample. It had not been in Dr. Wetmore's hands for many hours before his voice announced over the phone: "The material is down from the breasts of golden eagles!"

Try to imagine how many eagles it would take to provide enough down to wrap spirally into thick, fluffy strands the 1000 feet or more

of cord from which the blanket was made—certainly scores, perhaps hundreds. The mere labor of capturing so many eagles is convincing proof of the high status enjoyed by the old man, who was privileged to own a shoulder wrap so costly in time and effort and to wear it in death as a shroud.

### **His Life and Times**

Who was this old man? What had been his calling? Where had been his home? And when did he live? By piecing together over the years the bits of evidence gleaned by their specialized sort of detective work, archaeologists can answer these questions with a fair degree of accuracy. The primary fact is obvious: the old man was a full-blooded American Indian. His ancestral stock had settled the vast area drained by the San Juan River in Colorado, Utah, Arizona, and New Mexico, at least as early as A.D. 200. This people continued to reside in the area for 1000 years, or until shortly before or after A.D. 1300. Then a combination of forces dispersed the tribesmen to other localities already colonized, which lay southwest, south, and southeast of the old homeland. In those localities their descendants survive today as the Pueblo Indians.

When the first colonists of the San Juan country arrived, they seem to have been more hunters than farmers, but they had acquired the rudiments of agriculture and were beginning to raise corn and squash. They were skillful spinners and weavers of cloth, sandals, and baskets, and creditable artisans in such media as stone, bone, wood, and hides. However, they erected only the flimsiest sort of dwelling places and made no pottery at all. This was not for want of ability. So long as they were accustomed to wandering about in pursuit of game, there would have been no purpose in building homes that would outlast their stay. And pottery vessels would have been too heavy and too fragile to carry during their shifts from place to place.

When they learned of corn, the colonists acquired a possession of untold value, though they may not

have realized how greatly it would change the way of life of the coming generations. In a region where game and wild plant foods were never plentiful, the people came more and more to depend for livelihood upon the staple they could raise and to a large extent control. Here entered the coercive influence of corn. Fields planted with it had to be watched and tilled through the growing season, and it was equally necessary to guard the garnered crop until time for another planting. It was a question of settle down or go hungry. They settled down and soon began to develop along the two major lines that previously had not claimed their interest—pottery making and house building.

Progress was rapid. By the year 1200 pottery making had passed through experimental and developmental stages to become a fine art, with several centers of specialization in such features as form and type of decoration. Architecture kept pace. Dwellings were no longer single-roomed structures made of poles and brush and mud. Examples of the finest of them are the great stone cliff houses to be seen in the canyon shelters of Mesa Verde National Park, Colorado, and the huge community houses of Chaco Canyon, New Mexico, some of the latter four stories high and containing several hundred rooms. There was commensurate development in social organization and religious belief and ritual, with the result that by A.D. 1200, the descendants of the original colonists had achieved a kind and degree of civilization that few today fully understand and appreciate. Then, just as the zenith seems to have been reached, there came the conspiracy of adverse conditions that dispersed the people to other parts of the Southwest and left the old homeland untenanted until the coming of the Navajo, generations or perhaps centuries later.

### **From A. D. 200 to Present**

It took a long time for archaeologists to discover all this. Meanwhile, working in different localities upon remains representing dif-

*Continued on page 91*



▲ CLOSE-UP of the female Banded Garden Spider, dorsal view. Her outspread legs cover an area about three inches by two inches

➤ A GRASSHOPPER has just landed in the bottom part of the web. The spider makes a dash for her prey, trailing the safety line, which extends from the tip of her spinnerets to the center of the web where she had been resting. Note the zigzag signature

By WALKER VAN RIPER

Colorado Museum of Natural History

All photographs by the author

CATCHER of grasshoppers, sun lover, rain shedder, web shaker, signature writer, and web repairer, the Banded Garden Spider (*Metargiope trifasciata*) is especially interesting. It is one of our largest orb weavers and has world-wide distribution, being found in many parts of the Americas from Canada to Chile.

A full-grown female is about an inch long not counting the legs, and with the legs extended in the characteristic X-pattern in the web, the spider covers an area nearly three inches by two. She is beautifully marked and colored. A fine, dense coating of white hairs on her back gives a silvery gleam in sunlight, and her underside is dark

brown marked with yellow. The male is a relatively tiny and insignificant creature less than half the length of the female and not over a tenth of her weight.

As befits a spider whose favorite prey is grasshoppers, the orb web of the Banded Garden Spider is customarily placed close to the ground in exposed and sunny situations among shrubs and flowers. But unlike most of the orb weavers, this spider does not construct a nest or retreat. She hangs in the center of her web both day and night, unless unusually severe weather conditions force her to take shelter under some near-by leaf or branch.

She can endure the direct rays

of the sun on the hottest days of summer, at temperatures few animals can stand; and a shower of rain appears not to bother her at all. The high reflectivity of her silvery back may have something to do with her ability to withstand the heat. And the fact that the silvery white hairs point toward the head rather than the tail certainly provides the spider with an efficient rain shedding device, since she always hangs in the web head down.

The accompanying photographs, taken with the Edgerton high-speed flash at exposures of 1/5000 of a second, illustrate *trifasciata's* technique in handling a large grasshopper—in this case, the Two-

# THE BANDI GARDI



# SPIDER



Striped Locust, *Melanoplus bivitatus*. One feature that is not illustrated is a habit that this spider shares with a number of others—that of putting the web into violent vibration when it is touched by an insect or other agency. This obviously promotes the entanglement of the prey. It is interesting that some individuals of this species shake the web at the slightest stimulus whereas others do not do it at all. Spiders show many differences in personality like this, contrary to the common notion that creatures whose ways are determined by instinct must always react alike.

Attention has been called to the spider's "signature," the white zig-zag band of heavy silk extending

THE BANDED GARDEN SPIDER

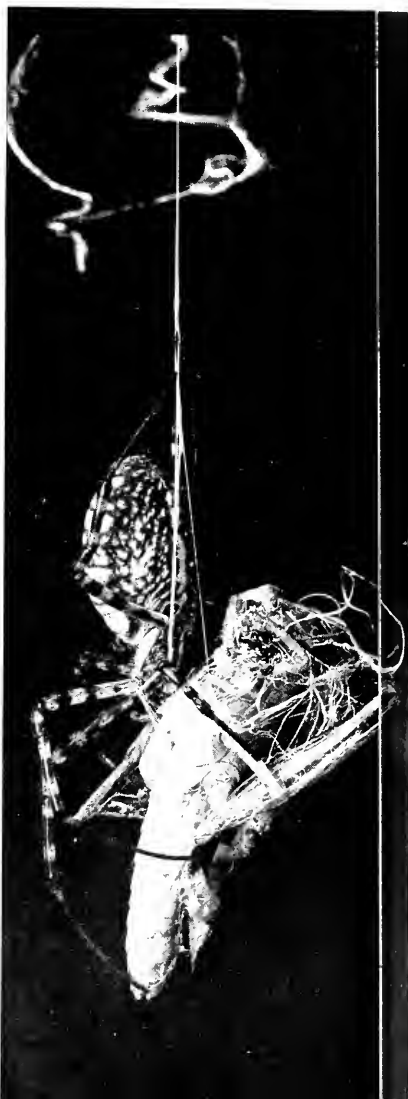


▲ HERE THE SPIDER is approaching her prey and spraying out the swathing band ahead of her from innumerable tiny openings, or "spigots"



◀ **THE SWATHING PROCESS.** The band of silken filaments from the spinnerets is guided and wrapped around the prey by the spider's hind legs while she revolves the insect by means of her front legs

▼ **WITH THE INSECT** entirely helpless and subdued, the spider for the first time administers the poisonous bite (toxic to insects but not to man). The spider will next draw the insect up into the web and anchor it where she can consume at leisure the liquid nourishment it contains



downward from the center of the orb. It is often heavier and wider than shown here. Sometimes it extends upward from the center as well as below; sometimes it is attenuated and shows only faintly; and at other times it is absent altogether. This band has been called the "stabilimentum" on the theory that it stabilizes and strengthens the web, but to my mind it has no utilitarian value whatever. Hence it is best called a signature, meaning simply that it is a characteristic of this spider's web.

The great French naturalist Jean Henri Fabre thought of the complicated process of web building as a sort of automatic chain reaction that the spider must go through from end to end without

interruption to achieve success. Thus she could not repair a damaged web but could only build a new and complete one. The Banded Garden Spider, however, is consistently a web repairer and will save the sound part of an old web and weave in the repairs necessary to make it serviceable again. This ability is of great interest, because it shows an adaptability to conditions — an ingenuity — which may properly be thought of as intelligence of a sort.

The Banded Garden Spider is harmless to man and is an efficient destroyer of insects. She and her web both display interesting decorative qualities, which make her further welcome in any nature lover's garden.



# Stars of DEATH

Exploring the breath-takingly lovely  
grottoes of Waitomo Cave in New  
Zealand—the home of the glowworm

By ALTON L. BLAKESLEE\*

*Photos by National Publicity Studios,  
Prime Minister's Department,  
Wellington, New Zealand*

visited this cave. Our careers, collectively, had taken us to many parts of the world, and we had witnessed many natural wonders in dozens of countries. But none of us could recall anything possessing the same breath-taking impact of sheer loveliness as the glowworm grottoes of the Waitomo Caves, 200 miles north of Wellington.

The Waitomo Caves are like numerous limestone caverns elsewhere—moist, chill, huge, and winding, with slow drops of water patiently building grotesque statues

▼ VISITORS MUST BE QUIET else the wary glowworms will turn off their lights

HOMEWARD bound from the 1946-47 Navy South Polar Expedition, the U.S.S. "Mount Olympus" rode the gray Pacific under a slaty sky, just out of Wellington, New Zealand.

In a stateroom, a scientist shook his head in a gesture of disbelief. "That," he said, "was simply magnificent."

He was thinking back not to Antarctica—the austere beauty of ice in mammoth cliffsides or delicate little castles, or the grandeur of icebergs or of glaciers spilling between mountains—but to a cave in New Zealand. For this is a cave with a brilliant underground sky of hundreds of thousands of living "stars," a cavern hung with silvery necklaces and echoing to the plinking music of dripping water. It's a scene of eerie beauty but all of it designed for tortuous, silent death so that some little worms may live.

During a week in New Zealand, more than a dozen of us from the expedition flagship—Navy officers, civilian scientists, and newsmen—

\*ALTON L. BLAKESLEE's first sea voyage came on ten days' notice when he was assigned to an Antarctic expedition as Associated Press correspondent. The present article recounts a highlight of this trip, which he considers his most interesting single assignment in eight years with the A.P. For more than a year he has been specializing in science reporting, the field in which his father, Howard W. Blakeslee, who is Science Editor of the Associated Press, was a pioneer.—ED.





▲ NATIVE ONLY TO NEW ZEALAND, these fantastic worms are the larvae of a strange fly, *Arachnocarpa luminosa*. Their lights are about half the size of a dime

and pillars and columns of stalagmites and stalactites. Dutifully behind a guide whose voice boomed in rolling echoes, we toured the caves one night.

"Now, gentlemen, please be quiet. We're coming to the glowworms. If you make noise, they'll turn out their lights."

A Navy doctor laughed. For weeks on our voyage there had been a standing joke about "ice-worms" supposedly found in the ice at Little America and tasting—so one veteran of a previous expedition maintained—like spaghetti. Glowworms rigged with push-button lights that switched off at the sound of human voices were a phenomenon in the same category. . .

From the dim recesses of one long cavern hall, we followed the guide, one by one, into a completely dark passageway and then stood thunderstruck. On the vaulted ceiling of this cave shone a carpet of blue-green stars, round and unblinking, massed thick as daisies in a field.

From the thousands of lights, each half the size of a dime, came a glow that slowly, as our eyes adjusted, etched the walls of this cave. The walls were torn and rugged, as by once-rushing waters. Beneath flowed a dark river, reflecting back each little pin point of starlight in

this buried heaven of the glowworm.

Suddenly the guide flicked the beam of a flashlight upward. The bright star-studded sky disappeared. Instead, we saw the cavern roof, creamy white and jagged and coated with small glistening sacs. From the roof streamed myriads of straight, gleaming, silky threads, a foot to two feet long. Each was gossamery as a spider's thread, but thicker, and strung every inch or so with a beadlike thread of mucus stuff.

Along the surface of the placid river there swarmed clouds of gnats, midges, and flies, coming upward to the "stars." Now one of the hanging threads vibrated. A gnat had brushed against it, sticking to it like an insect on flypaper suspended from the ceiling of an old farm kitchen. The guide snapped off his flashlight.

Then he began explaining. And as he did, in the cavern, dark save for the gleaming stars, the lights nearest to us flickered out. The glowworms were reacting to sound, as he had warned.

For all these stars are simply worms. They are the glowworm larvae, one stage in the fantastic life cycle of a strange fly (*Arachnocarpa luminosa*) native only to New Zealand. It exists nowhere else.

In the beginning, the fly lays its eggs upon the ceiling of a moist cave, over a slow-moving river. The eggs are fastened to the roof by a mucus glue. The egg hatches into a larva, or worm, less than an inch long and with a transparent skin that makes all its internal organs visible. This grub is dirty gray in color, slimy, fragile, and legless; it has a segmented body, and it carries its own lamp. In its tail segment, by chemical action, it produces cold light like that of the firefly but a lighter blue in color. It can keep this lamp lighted continuously or can dim or extinguish it at will.

The luminous worm shelters itself within a silken sheath attached horizontally to the cavern wall and saturated with a slimy fluid. This sheath is about two inches long, and the grub can undulate back

and forth inside it. From the sheath it suspends silken threads of mucus material exuded from its mouth. The threads, interspersed every few inches with a mucus globule and gleaming in the light like a diamond necklace, range from half a dozen inches to as much as two feet long, and one worm may spin fifteen to twenty of them.

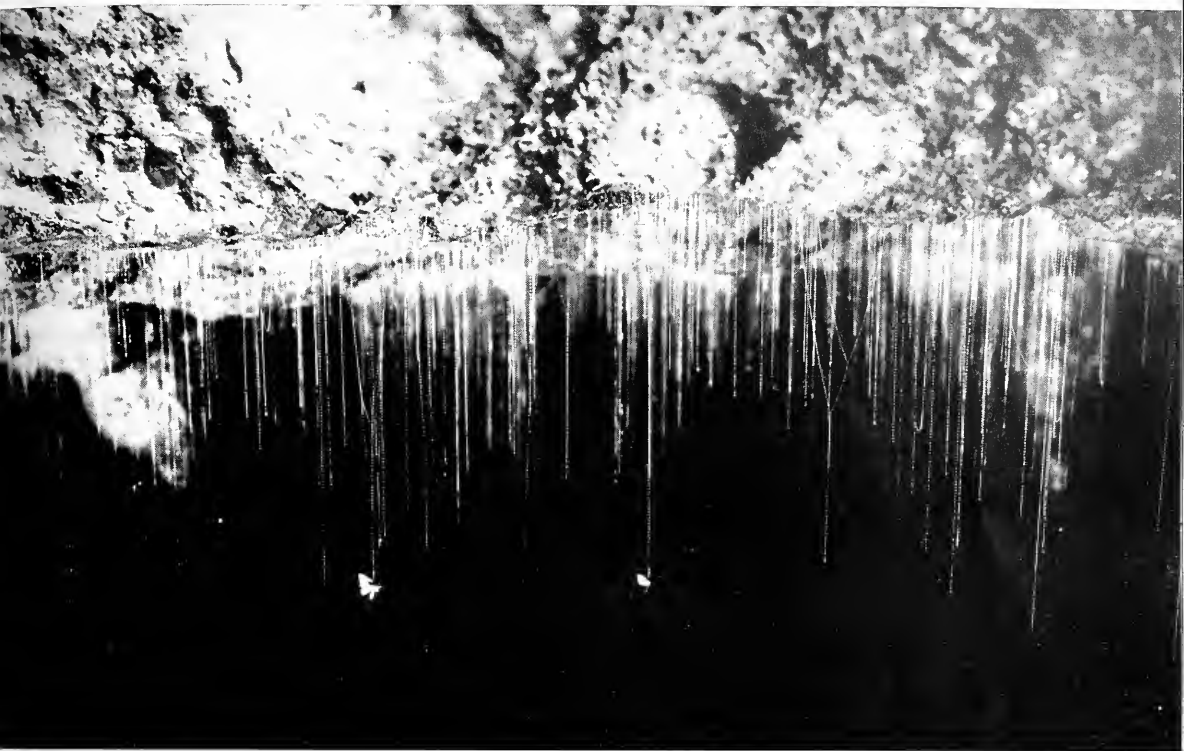
The threads are death snares for flies and midges living on the waters beneath. Attracted by the synthetic starlight, the midge becomes caught on the sticky thread and struggles violently to escape—but in vain. The glowworm reswallows the thread like an angler reeling in his line and devours its victim whole.

These beaded pendulums also serve as the glowworm's ears, transmitting the vibrations of sound and warning the worm of possible dangers.

The meat-eating or carnivorous stage of the larva lasts for several months. Then the glowworm reabsorbs all of its threads and changes into a chrysalis, hanging down on one single thread from its silken sheath. During this time it remains luminous but does not eat. A few days later, the adult insect, the fly, emerges. This fly is about twice the size of a mosquito—a dainty creature with dark wings. Little is known of the insect during this stage of its life cycle, for the adult fly shuns daylight and seldom is seen, our guide explained.

But later, when the adult circles up to the cavern ceiling to lay its eggs, it brushes past the hanging threads without becoming caught. It is an example of Nature's perfect planning—the young cannot devour their elders returning to start the life cycle anew.

Only in the Waitomo Caves have the glowworms been found in such numbers. In lesser profusion, they are known elsewhere in New Zealand but in no other country. Some are found in the Botanical Garden in Wellington, in moist pathways or in cuttings above river banks, but only in handfuls at a time. Drying winds and the sun shrivel their threads, which usually



▲ THESE SILKEN, MUCUS THREADS suspended by the glowing worms entice flies and midges into a snare of death. The threads are from six inches to two feet long

are shorter in length in these locations. But the moist, dark caves are a perfect environment both for the glowworms and for the midges, which hatch from eggs laid in the muddy river bank and provide an abundant food supply for the worms. Were the caves larger, the number of glowworms might well run into millions.

This one resplendent cavern was small, but our guide led us downward deeper into the caves to a small pier jutting out into the silent river. Cautiously we stepped into a large rowboat, and wordlessly the guide, pulling hand over hand on wires strung at shoulder height, drew the boat over the cool waters flowing gently over the muddy bottom.

Here the stars shone in such profusion—by the hundreds of thousands—as to make the Milky Way blush with shame at its own poor brilliance. From this tremendous underground galaxy—where some-

times neighboring stars etched the familiar patterns of well-known constellations—there came a soft suffusive glow that was bright enough to outline the grotesque forms of hanging fingers, the statues and castle spires of the limestone formations. Palely the light shone back from the river surface, and here the reflected stars danced from the ripples fanning outward from the gliding boat.

Rarely there comes a shooting star, a meteor streaking down out of this buried sky, when one of the glowworms for some reason falls. In this shadowy midnight darkness, a few shone now on the muddy river bank, glowing for a while like tiny lighthouses set in the midst of the blackened ocean.

Everywhere there was music, as water from the ceiling plinked in

uneven cadence upon the river, producing sounds silvery or deep in tone as the drops struck from greater or lesser heights. It was as though death strummed some inviting guitar.

For long awe-struck minutes we glided over the river, then wheeled in a wide circle, and suddenly these artificial stars paled in brilliance. Momentarily we were puzzled. It was not only that the stars were less richly massed; they also seemed dimmer. And then we realized—at this point the cavern wall opened upon the real night sky of the heavens above earth. We were looking at Nature's own sky of real burning stars, devoid of moon at the moment, and we found it small, sparse, and dim compared with the galaxy fashioned by delicate, ethereal worms, the stars of death.



# Exploring

## THE MISHMI HILLS

A vivid account of the trials and triumphs of a four-man expedition that penetrated the forest depths beyond the mighty Brahmaputra

By DILLON RIPLEY\*

All photos by Gertrude Sanford Legendre

**I** SOMETIMES think that luck is the key to everything on an expedition. If you have it, all will go well. If you don't, you might as well not have started. This thought was with me as I trudged through the freight yard at Tinsukia, in far northern Assam—a grimy, dirty place, well-known to American troops during the war, when it served a number of U. S. bomber and "Hump" transport bases. I had given up arguing with the freight master over the whereabouts of our jeep. He seemed unable to share my concern, so I had set out to search for it myself.

Ten days before, we had seen the jeep loaded on a flatcar in the Sealdah Station yards in Calcutta. It was lashed to the flatcar with its top up and loaded with boxes of food and equipment and several empty five-gallon cans for gasoline

and water. On top of everything perched two of our servants, whose job it was to guard the jeep with their lives night and day until it reached Tinsukia. Fortunately, it does not rain in December in northeastern India, but it is cold at night, so the two had bundled themselves up like Eskimos.

The sun hung like a red ball low over the freight yard. To the north, its faint light outlined the distant hills with an orange glow. Far away to the north and east lay our desti-

← MR. AND MRS. SIDNEY LEGENDRE, who accompanied the author into the Mishmi Hills, beside one of the jeeps

nation—the Mishmi Hills on the border between Tibet, China, Burma, and India. At this rate it seemed as if we would never get there.

A mid-Victorian shunting engine puffed by, wisps of smoke and steam eddying out from its spacious seams. Behind was a trail of flatcars loaded with surplus equipment from a former U. S. Army supply dump near by, now run by the Indian Government. The last flatcar carried a familiar outline. I shouted a "view halloo." Two muffled figures appeared and waved feebly. Luck was still with us. An hour of cajoleries, pleas, and angry words, and the jeep, under its own power, finally rolled off the flatcar onto a siding. Driving back to Chabua in the dark that evening, the Mishmi Hills at last seemed attainable.

With my companions—Mr. and Mrs. Sidney Legendre and Ed Migdalski—I had spent four days in Chabua waiting for our jeep and securing further equipment. We stayed at the former headquarters of General George Stratmeyer, erstwhile Commander of the U. S. Air Forces in the India-Burma Theater. The area is now used by the Indian Government Disposals staff. Miles of warehouses packed with a variety of U. S. equipment ranging from prime movers to Hershey bars were now the property of the Indian Government and were being sold to contractors and wholesalers from all over India. The scene was reminiscent of carpetbagging days in the South. Dealers seemed to pop out of the ground, and the air was thick with

\*The author, who is Associate Curator of Zoology and Assistant Professor of Zoology at Yale, has traveled widely making collections in the Far East. He holds the degree of Doctor of Philosophy from Harvard. Dr. Ripley has been associated with the Academy of Natural Sciences of Philadelphia, the United States National Museum, the OSS, and the American Mu-

seum of Natural History. On the Mishmi Hills trip, in addition to collecting birds for Yale and the U. S. National Museum, he collected over 100 mammal specimens for this Museum. He also spent two months recently in the Central Pacific and Japan on a survey for the Pacific War Memorial and the National Research Council.—Ed.



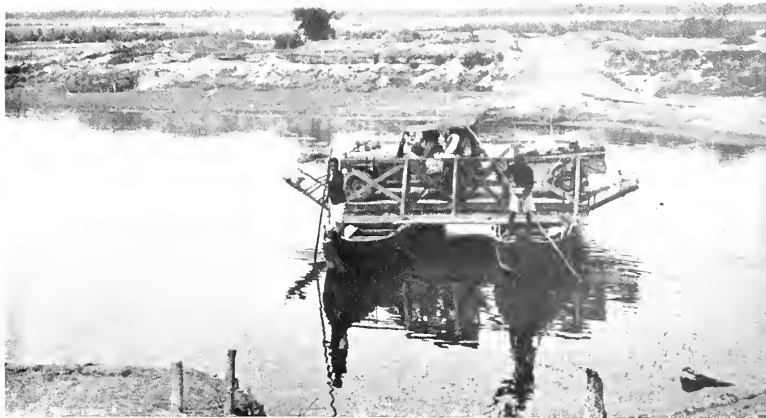
▲ A SNAKE CHARMER performed for the travelers at the Government Disposals Headquarters at Chabua, north Assam

conspiracy as deals were negotiated.

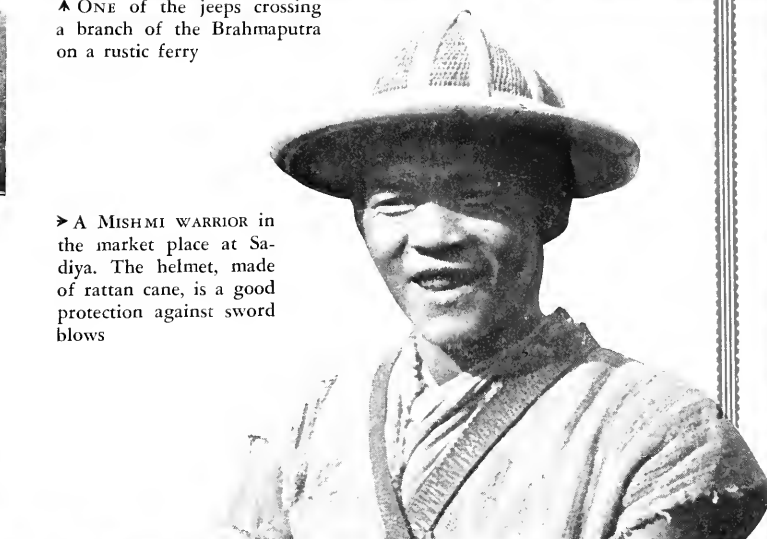
In order to transport the equipment for our joint Smithsonian Institution-Yale University Expedition to the Mishmi Hills, we needed another jeep and trailer. I had requested help from the Assam Government and had been told that we would be allowed to buy back a very tired U. S. Army jeep for \$1000. For one month's use the price seemed beyond our expedition's budget! We finally found an accommodating Indian friend among the pariah horde of businessmen who agreed to loan us a jeep for a month. Luck was still on our side.

Our four-day stay had given us a chance to see that the business of disposing of surplus property

➤ BEFORE moving into the Mishmi Hills, the expedition's tents and stores were given final inspection in front of the resthouse at Sadiya, Headquarters of the Frontier Tracts Administration



▲ ONE of the jeeps crossing a branch of the Brahmaputra on a rustic ferry



➤ A MISHMI WARRIOR in the market place at Sadiya. The helmet, made of rattan cane, is a good protection against sword blows





▲ THE JUNGLE was so impenetrable with its thick growth of rattan that camp sometimes had to be made in the dry bed of the Lohit River

► ROLLING STONES covered with smooth algae made crossing the Lohit River shallows a treacherous business



was not all that met the eye. There were "Day Disposals" and "Night Disposals." Day Disposals involved paper work in the front office and the actual paying for things. Night Disposals cut through the red tape. The contractor simply drove up to a warehouse in his truck, carefully lubricated the necessary palms, and went away with the goods!

It was a chill, crisp morning when we left Chabua in a small convoy of two jeeps with trailers and a borrowed 6x6 truck. Accompanying us were two bearers, a cook, two taxidermist assistants, and ten porters from the Naga Hills who would carry our burdens when the roads became "unjeepable."

From Tinsukia there is a good road leading north for about 35 miles to the bank of the Lohit River. A few miles to the west of this point, the great bulk of the Brahmaputra swings north to the gorges leading to the high plateau of Tibet. But the Lohit, one of the main feeders of the Brahmaputra, continues upstream in an easterly course, cutting off and isolating the extreme northeastern tip of Assam. North of the river, normal government administration stops. The area is known as the Frontier Tracts and has its headquarters in Sadiya, a small village across the stream.

The Lohit is a big river well over

a mile wide, with a huge, flat bed of sand and clay. In summer, heavy rainstorms make it impassable for weeks at a time, but now, in December, it was a 300-yard-wide stream easily navigable by ferry. We crossed in installments on a ferry made of two wooden boats lashed together and propelled by a rickety Chevrolet automobile motor. North and east we could see the Mishmi Hills clearly. Their upper heights, towering to more than 9000 feet, were edged with the first winter snows. A few small, white river terns darted low over the stream, and high overhead a fishing eagle soared.

Sadiya nestles at the foot of the Hills within a 40-mile perimeter known as the Administered Territory. Beyond is the Unadministered Territory, which extends for another 20 to 40 miles to the rather indefinite boundary area where the four countries of Tibet, China, Burma, and India meet. Lord of all he surveys is the British Political Officer who rules from Sadiya. It was within his jurisdiction to tell us where and how far into the Hills we could go. Major Allen was kindness itself and assisted us throughout our stay. But he was dubious about how far we could get into the Hills.

"It's not so much that it's dangerous," he said. "The Mishmis

don't kill white people, but there simply aren't any porters."

He went on to explain that the Mishmis were divided into four subtribes and that where we were going, farther up the Lohit Valley northeast of Sadiya, the people were quite harmless.

"In fact, they're simply sodden with opium," was the way the Major explained it.

The situation was different, he told us, just to the north of Sadiya, in the Hills that border the gorges of the Brahmaputra. There the Chulikotta Mishmis, a proud and warlike people, at one time annually raided the plains beyond the river for slaves and women, and they still ambushed each other from time to time over family squabbles.

"Their favorite way of killing each other," said the Major, "is to shoot a man on one of their narrow cane suspension bridges. Then, even if he is only wounded by their old blunderbuss, he's sure to fall and die on the rocks below without having seen the face of his ambusher. Neat, isn't it?"

But our Mishmis were quiet little people. Their only trouble was that they were so preoccupied with opium that they would have no time to help us carry our equipment, trap birds or animals, or even guide us. We finally secured a headman called Atlum, who was guaranteed





▲ ATILUM, mighty hunter and chief assistant in the Mishmi Hills



▲ CANOEING along the Lohit was one of the best ways of finding game in this lowland of knotty jungle

▼ HINDU PILGRIMS on their way to a holy spring and shrine at Brahmakund, up the Lohit River



to be a great hunter. Atilum, tall and dignified, had long, straight, thin hair and a slow smile that was very engaging. He wore a breechcloth, a coat of dark, woven material, a black turban, beads around his neck, and on festive occasions, the bright red, cloaklike garment furnished by the Government to indicate his rank. I rather wondered when the opium pipe was going to appear. Mishmis grow their opium in the Unadministered Territory, and it is not easy to control its passage into the Administered areas.

In Sadiya we stopped at the last store we would see for a month. It was a cavernous place, hung about with a profusion of useful things—coils of rope, kerosene lamps, shovels, cloth, trinkets for the Hill people, tobacco, and sacks of rice. And crowning all was a frieze around the higher part of the wall, which consisted of framed chromo pictures of an entire Hindu pantheon of gods, in frenzied poses. We bought 500 pounds of rice, dahl

or pulse, curry stuffs, coconut oil, and dried fish for our Naga boys, Indian staff, and Atilum; kerosene lamps, kerosene, and gasoline for the jeeps; and a miscellany of blankets for everyone. The temperature at night was down in the low forties.

From Sadiya the jeepable road stretches about 40 miles or so north-east. For the last few miles it rises gradually until one reaches Denying, formerly a frontier fort, now a small post manned by the Assam Rifles. The altitude is about 2500

feet above sea level. Here we decided to stay to make our first bird, animal, and ethnological collections. But it was not too easy to reach Denying. The truck refused to be carried in the tiny ferry over the Kundil, one of the tributaries of the Lohit River, and so some time was lost before we became established.

Denying consists of an opening in the jungle on the side of a hill, commanding a view of a continuous sea of jungle below. There are, per-



haps, four or five Indian families living there, and they maintain a store, telegraph service, and a minute hospital. Otherwise, there is a small floating population of Mishmis who move about seasonally from patch to patch of scrub cultivation.

The jungle is impressive. It is a very high rain forest that presses tightly about one. The trees are immense, and the crown of the forest seems a good 200 feet above the road on the flat. The forest is silent but not dank. It is rather dry, and walking is pleasant once you are above the area where the thick underbrush of rattan or cane grows. Rattan, a palmlike vine with long, slender, arching fronds, is covered with a profusion of small spines designed to slow your progress to just below that of a caterpillar. The long, slender tips of the leaf-ends hang invisibly in the shadows and sweep off your hat or scratch across your face with monotonous regularity. In such country only the elephant is comfortable, and most of the smaller, thin-skinned animals, including man, stick pretty much to the elephant trails.

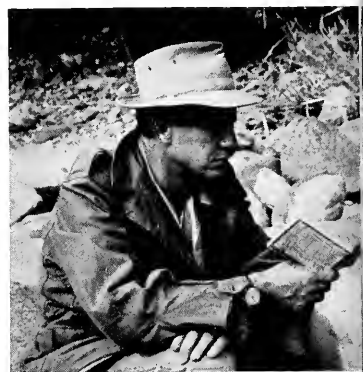
Wild elephants are plentiful in the flatland near the river beds. We saw none during our stay but heard them several times while walking along their erratic trails. Sometimes when I would shoot at a bird in the jungle, I would hear a sort

of warning stomach rumble from a near-by elephant. I could never see the animal, but, judging from the sound, it could not have been as much as 100 yards away. Deer, both sambar and the small barking deer or muntjac, also seemed very common. The one time we encountered Mishmis in number was when we shot a deer. News like this seemed to spread in some miraculous way, and, as a result, meat never seemed to last for more than one meal. Leopard and tiger are apparently common, although the heavy, thorny undergrowth is not to their liking. We always saw their pug marks, very often fresh, in the sand of the stream beds.

After we had been in Dening a few days, my friends the Legendres, decided to try for a tiger. I was too concerned with hunting birds to do more than wish them success. They had an extraordinary experience. Leaving Dening, they took Atilum, the mighty hunter (still an unknown quantity), some Naga boys, a tent, food, etc., and set off for a big dry river bed below. On the way, they "picked up" an elephant, secured by Major Allen. In the manner of a medium tank, the elephant was to carry them over the rough spots and especially through the jungle where rattan was particularly abundant. The first disappointment came when it was discovered that the elephant

loathed Mishmis of any description and would have nothing to do with them. Whether this was a basic objection on anthropological grounds, or whether the elephant was only expressing a plausible social objection of the type popularized by the soap ads, was never discovered. Whatever the cause, the result was that poor Atilum was forced to direct events from afar whenever the elephant was around.

After two days of this and of some very rough going over heavy boulders, Mrs. Legendre, by great luck, had a wonderful view of a tiger, a large one, carrying into the jungle by brute force a huge water buffalo that it had just slain. She fired and probably wounded the beast mortally, but because it was doubled up from the weight of the buffalo, it was presumably hit in the stomach. The tiger immediately leaped back into the jungle and proceeded to make a most stupendous series of roars, evidently expressions of rage. At this point, the elephant was engaged to deploy the



▲ MR. LEGENDRE killing time while the expedition's temperamental elephant decides whether to pursue a wounded tiger through the jungle

◀ ELEPHANTS are wonderfully mobile in the open or when traversing muddy streams, but this one loathed the jungle

► TRAVELING in north Assam is more efficient by elephant—unless you are one that doesn't like Mishmis in the jungle!

hunters through the jungle on the tiger's trail. Here the second great disappointment occurred. It appeared that the elephant loathed the jungle second only to Mishmis and balked absolutely at going into the mass of underbrush and rattan. Nothing would induce it to set foot in the jungle, and as anyone knows who has tried, there is nothing to do with a balking elephant except accede to its wishes. Consequently, the Legendres withdrew to a camp perched beside the jungle on the river bank.

After dark a tiger, possibly the wounded one but more likely its mate, arrived and proceeded to stalk around and around the camp all night, roaring hideously. The camp consisted of a tent, a fire, and Atilum. The Nagas and the elephant were some distance away, and as it later developed, all except the elephant spent the night in trees. The Legendres' one protection was the fire, for they could not see the beast to shoot at it; and by morning their hands were covered with burns from their efforts to keep the blaze going. The tiger or tigers were never seen again, and that ended the hunt. The temperamental elephant was dismissed, and Atilum drew out his opium pipe and proceeded to smoke ten separate pipes before breakfast.

Meanwhile, all had been going well at Dening. We were finding

the birds very interesting. Each morning and evening, Ed and I would set out in different directions, armed with a shotgun and a variety of small-sized bird shot and trailed by a Naga boy carrying our knapsack. Our first stop would be at the bird nets—cunningly made affairs of black silk which are used by Italian bird trappers for securing food. In these bird nets, set in clearings in the forest, I caught several species of birds that I had never seen in life, and of them at least two are new to science.

From the nets we would proceed to wander apparently aimlessly through the jungle but, in fact, listening carefully and proceeding cautiously. At any time we might come upon a small flock of birds passing rapidly through the undergrowth. Every day we saw many species of bulbuls, flycatchers, and warblers. Others we might glimpse only once in a mixed flock of small birds and then never see them again. Always I was on the lookout for the smallest birds, particularly wrens. There is a great variety of wrens or wrenlike species in these hills, and they are extremely difficult to trap or shoot. But without capturing a few of them, we would never be able to determine just what species we were dealing with here in these Mishmi Hills. In fact, no wrens had been collected here before, for only two bird col-

lectors, and both of them part-time amateurs, had ever visited the Mishmis.

Often during the morning I would stop and listen, and sometimes I would hear a sharp "tchip" or a longer, drawn-out "tchirik," both the calls of some species of wrens. These tiny birds dance about so incessantly on the small branches of bushes low to the ground that it is almost impossible to follow their movements. They have a curious habit of skipping back and forth on one branch, keeping the body almost still but moving the little legs sideways, back and forth. As far as collecting these tiny creatures was concerned, I found, like most collectors, that if I saw the birds, they were within five or six feet of me, too near to be shot, and if I tried to back away to shooting distance, they were no longer visible.

Below Denning is a big river, reached after a steep descent from a cliff several hundred feet high. It was here on the bank of the stream in a wet, leafy tangle of brush that I had one of my most tantalizing encounters with a wren. The sides of the valley were touched with gold from the early sun, but down by the stream it was still rather cold and damp. A tiger had passed that

▼ MRS. LEGENDRE stares despairingly at the reluctant pachyderm



EXPLORING THE MISHMI HILLS





◀ WARMING HANDS over a fire on a cold January morning before setting out to collect specimens

▼ THE AUTHOR collating Mishmi ethnological material collected for the Lewis collection at the Peabody Museum at Yale



way early in the night; perhaps he had been trailing a big sambhar stag, whose prints were splashed through the sand, far apart. The churning water, here white with foam, there cold and green, billowed over the rocks in a torrent, drowning out all but the nearest sound.

I had been pursuing one of the most enchanting Himalayan birds, the brown dipper, a stubby fellow the size of our robin but the shape of a wren. Its haunt is along and even in such streams, for the dipper thinks nothing of plunging into the rapids and walking about under the water. As I leaned back against a rock, a great Himalayan pied kingfisher swept by in a strange, jerky flight, looking as big as a



crow in the small enclosure. But my attention was distracted by a little chipping noise just behind me in the undergrowth. Turning as quietly as I could, I spied a dark shape moving in the gloom of the tangled roots and branches. It was a small,

brown wren of a species I had never seen before, and it was so close that I could have stretched out and touched it. I could see the flecks of black on its dark brown back. It was scuttling about like a tiny shrew—now on the ground, now under some exposed roots, now on a low branch a few inches off the ground. All the time it kept up a continuous, scolding series of clicks and chucks in a rather sharp, irritated tone.

I realized that any movement on my part would scare the tiny bird away. Helplessly, I had to watch until it disappeared down a hole under some boulders, and it did not emerge. For all I know, I may be the only ornithologist who has seen this particular species or subspecies of wren alive.

◀ SO VIOLENT are the monsoons in the Mishmi Hills that the rivers rise to great heights. As normal bridges would be washed away, the Mishmis erect temporary structures that are renewed each year





◀ MISHMI AND ABOR WARRIORS. The central figure is one of the Government-appointed headmen in his scarlet robe of office

▼ THE CHULIKOTTA ("cut hair") are the most warlike of the Mishmi tribes. Their favorite technique is assassination by ambush. Note the lady's bangs

A week later, we moved on up the hills to Dreyi, a small outpost of the Assam Rifles, a few hundred feet below the crest of a long 6000-foot ridge called the Tidding Saddle. We stayed for a week collecting birds and hoping to hear word of the Takin, a mysterious goatlike relative of the cow. This animal has a heavy, gray, shaggy coat like a yak and strangely curved horns like a gnu. It normally descends to the salt licks in winter. But it proved elusive; and, lacking Mishmi porters, we were unable to pursue the hunt.

Our climb up to Dreyi was long and tedious, although the trail was an easy one. Our Indian taxidermists and servants were not accustomed to this sort of climbing and rather tended to fall by the wayside. The only tragedy involved the cook, who fell down a bank and lost his glass eye in the process. I came upon him sitting beside the path and emitting a shrill wail of despair. Fortunately, the loss of the glass eye had no effect on his cooking, which was no better or worse than it had been before.

Dreyi is a great place for barter and sunsets. It is situated on one of the Tibetan trade routes, and every day during this season small groups of wool-robed Tibetans came down over the Saddle on the last lap of their journey. Ed would always stop them and feel about in their packs for some article that captured his fancy. If he found it

—a Tibetan coin, a small knife, or a bamboo or woven box—an active trading session would commence, with cigarettes first offered to soften up his opponent, then possibly some chocolate, and finally a judiciously displayed Indian silver coin or two. The Tibetans enjoyed this sort of thing very much.

Our greatest pleasure in Dreyi was to walk to the outskirts of the village every afternoon. We would rest on a small plot of green grass on the edge of a spur of the Hills and look far out to the south and west, over the intervening lower hills to the plains below. Far away wound the ribbon of the Brahmaputra with its intersecting rivers, the Lohit, the Tezu, the Kundil, and the Dibang. As the sun turned into a red ball on the horizon, the rivers seemed to be streams of molten metal flowing directly out from the mouth of a round furnace. All the colors were there—reds, purples, and oranges—until finally darkness came, and with the moon the ribbons reappeared, this time casting silver from the velvety black of the forest.

A few more days and our visit to the Mishmi Hills was over. Once again we crossed the Lohit after saying good-by to our friends in Sadiya. To Atilum I gave a farewell present of a miniature camping stove for his family. I suppose he will turn it to good use in his quest for opium. To the Nagas who had served us so well we gave presents



of blankets and clothes and then saw them off to their hills.

As we packed our gear and our jeep, the railroad yards of Tinsukia had never appeared grimmer, the trains never so shabby and dirty. Our eyes yearned for our last glimpse of the Mishmi Hills, blue on the horizon, their snowcaps twinkling with a clean white. Luck had been with us; we had secured many valuable specimens, and the whole Mishmi trip had been sheer delight. Some day I hope my luck holds long enough to send me back in search of that shrewish little wren.

# Watching the OSPREY in Lower California

Two ex-Navy men sail a 23-foot boat to a desolate wilderness along Mexico's coast to study the habits of a declining bird

By KARL W. KENYON

U. S. Fish and Wildlife Service



Photo by Karl W. Kenyon

▲ THE UNCHARTED AND TREACHEROUS WATERS of Scammon Lagoon trapped the "Seven Seas" on a sand flat. Here aboard the grounded sloop, Woody Williams talks with Mexican fishermen, who rowed from shore to help pilot the sloop to safe anchorage

THE lapping of water against the hull and the banging of rigging had become routine sounds aboard our small sailboat, but a plaintive chirping note that roused me in my bunk was confusing. As I lay for several seconds struggling to integrate the unusual combination of sounds, the chirping note grew louder and was joined by several sharp, whistling calls. Then I remembered where we were. The bird sounds of Scammon Lagoon were announcing a new day.

We had dropped anchor several hours after sunset in the inky darkness of the previous evening. This lagoon is an extensive arm of the Bay of Viscaïno and cuts deeply into one of the most desolate areas of Lower California's deserts. Earlier in the day we had followed a tortuous course down an eight-mile channel flanked on both sides by roaring breakers and had headed confidently across a stretch of quiet, uncharted water. Our only reference points on the hazy horizon were one small, dark blob and a stretch of distant, white dunes. The dark blob looked like the best bet, so we headed for it. Then, with-

out warning, we found ourselves trapped by the receding tide on an extensive sand flat. Fortunately, the black spot on the horizon turned out to be the driftwood shack of six Mexican fishermen encamped on a low, sandy island. These men rowed several miles against strong currents and a stiff breeze to render us valuable aid, and we now lay safely at anchor near their camp.

Woody Williams and I, after four years in the service, had provisioned our 23-foot auxiliary sloop, the "Seven Seas," for a two-month cruise along the waterless and nearly uninhabited coast of the peninsula of Lower California, which is the part of Mexico below the California border. We had sailed out of San Diego harbor on the twenty-sixth of March and with many exploratory stops along the way had taken nearly three weeks to reach Scammon Lagoon, about 360 miles south of the border.

The lagoon was our main objective, since it is a wilderness area inhabited by a variety of wild creatures and is seldom visited by other than a few fishermen. By land the area is almost completely isolated, for only a few tracks over an uninhabited desert lead to its shores. Few visitors care to enter from the sea because of the extensive breakers that constantly pound the bar at the mouth of the lagoon. Thus we expected to find an interesting

region in which to study birds and sea animals that were comparatively undisturbed by man.

Our first view of the lagoon from "on bottom" had not prepared me for what I saw when I shoved back the hatch cover. A flat expanse of white beach stretched eastward, and on both sides of the small, deep channel in which we lay, gray sand flats spread broad, glistening fingers into the distance. Scattered in bold relief on the surface of the little island were numerous black spots, which I later discovered were the nests of ospreys. The wet sand flats swarmed with long-legged shore birds. Several black and white Frazar Oyster Catchers whistled loudly as they engaged in a noisy courtship performance.

The chirping that had awakened me continued with monotonous regularity. The voice sounded very near, and I suddenly realized that it was coming from just above my head. Hovering over the masthead and appraising me with a cold, yellow eye was an osprey. In this treeless area the top of the mast evidently appealed to it. However, the slight but constant motion of the boat seemed to make the perch too unsteady for its taste, and after several attempts to settle, the osprey gave up the adventure and glided to a small stake on the near-by shore, where its plaintive chirping continued.



► A YOUNG OSPREY spreads its wings in the strong sea breeze. Although these young birds are almost as large as their parents, they have not yet ventured into the air; and they look quite aghast when a strong gust of wind combines with their experimental flappings to lift them several inches off the nest



*Photo by Karl W. Kenyon*

▼ SETTING UP the photographic blind. The osprey nest to the right, which is almost indistinguishable against the grass, contains two young birds, crouching and nearly invisible. The black spots on the horizon are also osprey nests



*Photo by Milo W. Williams*

The American Osprey, or fish hawk, as it is often called, although widely distributed in North America, has shown in recent years considerable decrease in certain parts of its range. Where once it was plentiful it now hangs on with a mere remnant of its former numbers. For example, the osprey was formerly numerous along the California coast and on the near-by Channel Islands, even nesting along the Sacramento River and, in the very early days, on the shores surrounding San Diego Bay. Now an

osprey in these coastal areas is a rare sight. I had looked forward to finding the osprey almost undisturbed along Lower California's lonely coast, but even here the bird appears to be fading with the years into obscurity. Although there are still a considerable number of breeding pairs, they are fewer than past observers have recorded. The large colony in Scammon Lagoon seemed to be one of the most prosperous of the groups we encountered.

After assembling our field equip-

ment, we rowed ashore in our dinghy. Here we found that the island, which from a distance had looked like white sand, was in reality composed largely of layer upon layer of bleached scallop shells. Although the fishermen occupied the tip of land nearest our anchorage, the birds were in full possession of the rest of the island. The long-winged osprey, whose chirping constantly smote the ear and whose bulky nests of sticks and rubbish were the only dark objects on the white expanse, were by far the most striking birds. Some nests, composed of the remains of Green Turtles, piled sticks, seaweed, and bones, reached a height of five feet.

While Woody headed for the mud flats armed with bucket and dip net, I started a tour of the island conducted by Carlos, good-natured leader of the little group of fishermen, who kindly offered his services as guide and camera carrier. As we walked the length of the little island—a distance of about three-quarters of a mile—the din overhead remained constant. But the ospreys alone weren't responsible. The Western Gulls, just starting their nests, vented raucous profanity as we trod close to their

newly scooped hollows in the sand. Oyster Catchers, too, added their shrill whistles to the other bird sounds. I wondered if this were the real meaning of the term "howling wilderness."

But the chirping of the ospreys, more by its persistence than by its volume, dominated all other sounds. And they held the limelight in another way, too: We underwent a perpetual barrage of aerial diving attacks, scarcely rivaled in spirit by the Kamekazis themselves. However, the ospreys judiciously "pulled out" just in time (or perhaps my frequent ducking was effective), for I was never struck. As we moved from one nesting area to another, the attack was launched anew.

The variability of the nests impressed me. But the ospreys seemed equally attached to their home whether it consisted of a depression in the sand, scantily lined with a handful of marine algae, or a hastily assembled scattering of sticks, or a massive structure nearly five feet high with penthouse and view. There was equal variation in the families they contained. In stage of development, the young ranged from chicks just out of the egg to two-month-old birds that took short flights on unsteady wings. Several nests contained newly laid eggs or eggs more advanced in incubation.



Photos by Karl W. Kenz



▲ FATHER OSPREY swoops in to dip for food, while the mother takes a few hasty steps to be on the spot when the fish hits the nest. The light tips on the feathers of the young birds easily differentiate them from the adults

◀ CONTENTED AS A HEN, this osprey protects her chicks from the chilly winds, constantly shifting sands, and merciless rays of the sun. Unlike many osprey nests, which are often large and bulky, this modest affair consists of little more than scattered pieces of marine algae and a handful of twigs



Many species of birds show an aggressive attitude toward intruders that is comparatively mild when the eggs are first laid but increases in intensity after the young hatch and during their development. Although this was generally true of the ospreys of Scammon Lagoon, variability in behavior among individuals was obvious. Some birds wheeled at a respectful distance, chirping their annoyance in slightly restrained tones, while others in similar circumstances screamed their hatred and pressed repeated and menacing diving attacks.

The individuality of the birds was demonstrated again when I set up my photographic blind. Whenever I arranged this alone, the ospreys flew close overhead, peering down suspiciously and constantly uttering irritated chirpings. So I discovered that a "go-awayster" was always necessary. The "go-awayster" is an extra person who accompanies the photographer to the blind and then leaves, so the birds will think the coast is clear and return to resume domestic activities.

However, I discovered that several pairs refused to return to their nests even after the "go-awayster" had departed. Their suspicion of the blind was too strong to be so easily overcome. On the other hand, some parent ospreys would eagerly return to the nest when the "go-awayster" was only 50 yards away. One such unsuspecting bird was so complacent that in moving my blind to a better position, I shifted it on my back, turtle fashion, without ruffling her composure, although her nest was only eight feet away. I moved to within three feet of her, and later, when I emerged from the blind, she still hesitated to quit her nest.

The osprey is well known for its tolerance toward birds that it considers harmless. Small birds such as the English Sparrow and Starling are sometimes reported to build their nests in the bulky foundations of an occupied osprey nest. I found it a very interesting experience to watch a display of osprey hospitality from my blind one afternoon. An osprey had just returned to her nest and was busy arranging her

two newly hatched chicks when a Ruddy Turnstone walked boldly to the edge of the nest, apparently after fish scraps dropped by the ospreys, or insects attracted to such scraps. The osprey finished settling herself and began to preen her feathers while the turnstone foraged within a few inches of her. Each bird showed complete unconcern toward the other. When the large host turned her head, the little visitor walked directly under her bill. Unfortunately, I was changing film at this point and so missed the best shot.

On the other hand, the osprey recognizes potential nest robbers at a distance. An osprey on a nearby nest suddenly screamed and headed with "throttle to the firewall" for a couple of ravens, apparently minding their own business as they skirted the water's edge about 50 yards away. The ravens, startled by the sudden attack, parted and fled, while the osprey returned to her nest with the light of victory shining in her eyes.

Family raising is a long operation for the osprey. The eggs must be incubated for approximately 26 days, and the young birds then remain in the nest for about 8 weeks. It seems evident that in Scammon Lagoon the nesting season covers an extensive period. Conditions as we found them during our stay, from the latter part of April to the seventh of May, indicated that the first eggs were laid during the last days of January, and all of the young birds would not be ready to leave their nests until the end of July. Thus the osprey colony of Scammon Lagoon would be occupied for at least six months of the year.

When first hatched, the completely helpless young osprey ignores the frantic distress calls of the parents. But as the days pass and the spark of consciousness flickers into understanding, they learn to assume a tense, protective position, which consists of "playing possum" on the floor of the nest. Unlike other hawklike birds, the young ospreys are particularly well fitted for this, for instead of being covered by white down, they are strikingly marked with a pattern of

sepia brown and buff. From a distance of a few feet, it is almost impossible to detect the young birds, so well do their markings blend with the background of sticks and seaweed. On close inspection the only sign of life is the intense, staring eyes. Even if picked up and handled (under much protest and some danger from overhead), the young will usually hold their pose instinctively. If the bird is well feathered, however, the chances are that it will suddenly break from the hypnotic spell and present a fearsome array of clutching talons and gaping bill in protest to this unwelcome indignity.

Young birds that are almost ready for their first flight sometimes assume a very menacing stance in the nest. If an intruder steps too close, the head drops below the hunched shoulders, feathers are raised, and an impressive ruff around the back of the head is extended. Actually the bird is frightened, but it gives a convincing impression that it is a fearless, blood-thirsty demon. The strain of holding such a position soon tells, however, and the bird slowly sinks to a squatting position, the wings droop, and apparently the idea of looking fearsome is lost.

Very versatile in selecting nesting sites, the osprey is not limited in placing her eggs to a flat area of sand or a five-foot pile of sticks as is the custom in Scammon Lagoon. She seems equally at home on the apex of pinnacles in Yellowstone Park or atop a telephone pole or a tall tree. I found one bird satisfied with her three eggs on a few handfuls of seaweed in an old fruit box which the tide had washed ashore. And a pair of ambitious home builders heaped several handfuls of sticks on top of my blind when I left it for several days. The burlap covering, whipped by the afternoon sea breezes, scattered the sticks over the beach; but in the calm of the following morning the birds reappeared and began to replace the foundation of their dream house.

In spite of the prosperous colony of ospreys in Scammon Lagoon, which consisted of 27 actively nesting pairs, we found that the popu-



Photo by Karl W. Kenyon

▲ A RUDDY TURNSTONE finds the osprey nest an attractive foraging spot and the osprey a gracious hostess. Ravens, on the other hand, which sometimes passed near by, were angrily chased from the nesting area

lation was not what it had once been. Published accounts of years past list the osprey as a common bird along the coast of Lower California. The casual observer today would still call it common, for it may be seen in a great many regions offering conditions that naturally favor its existence. But the term "common" should be used with qualification as exemplified by the situation on the small volcanic island of San Martin.

In the several days we spent there, I hiked over the entire broken surface of this little island and located only three pairs of ospreys that were nesting or preparing to nest. They constituted the entire osprey population on San Martin. In 1913, the population was said to be 30 breeding pairs. Although precise figures are not available for all osprey breeding places along the coast, a reduction in numbers at other points is evident.

What has become of the ospreys? Thoughtless fishermen frequently use an osprey nest perched on a cliff as a target for idle rifle fire. One afternoon I dug several slugs from the sandstone cliff behind such a nest.

But more important is the osprey's low and slow rate of reproduction. Generally speaking, ospreys are considered to lay three or four eggs. I found that quite a number of nests along the northwestern half of Lower California contained only two eggs or young birds. The eight-week period in the nest may expose not only the young but the parents to repeated barrages of rifle fire. That a few eggs and young birds are eaten by hungry fishermen now and then seems a negligible point. Judging from the remarks of one of my Mexican friends, one meal of "eagle chicks" is all anyone would ever want.

The osprey appears to be a hardy

bird in many ways and is subject to few natural enemies. In the more remote areas seldom visited by man, such as Scammon Lagoon, we found the birds holding ground quite well. But they may eventually be decimated even along the lonely stretches of the northwestern coast of Lower California, as they have been to the north in California. The osprey was once common in the British Isles; now it has become extinct there. It is to be hoped that the same thing will not happen in this section of Mexico.

We left Scammon Lagoon reluctantly but with a great sense of satisfaction. Although the area is generally considered desolate and uninteresting, the presence of the ospreys alone made our visit rewarding. As the "Seven Seas" beat her way against the prevailing northwesterlies, we hoped that Lower California had not seen the last of us.

## TOMB OF THE WEAVER

*Continued from page 71*

ferent stages of cultural development, each fieldman had a tendency to give a distinctive name to the particular group whose accomplishments he was investigating. As a result, archaeological literature is cluttered with titles such as Basket Makers for the colonists to emphasize the fact that they made no pottery; Post-Basket Makers or Slab-house People for those who were just beginning to make pottery and provide better dwellings for themselves; Pre-Pueblo for those a little later who made better pottery and had gotten a start in masonry construction; and Cliff Dwellers for the occupants of the great Cliff Houses of the Mesa Verde. The best thing that anyone who does not expect to become a specialist can do is, at the outset, to convince himself of what the archaeologists at last have learned—namely, that with few, if any, exceptions the old ruins, refuse heaps, and burial places that occur so plentifully over the northern Southwest are the work of the Pueblo Indians and their ancestors between the year A.D. 200 and the present.

### Clues and Deductions

But to get back to our Old Man. He was, then, an ancient Pueblo Indian. He belonged to a group who dwelt in Canyon del Muerto, a long and tortuous gorge in the northeastern corner of Arizona. His principal occupation can be deduced satisfactorily from things buried with him. Among the Pueblo, the men are and always have been the makers of cloth. Two blankets (one old, one new), some two miles of fresh-spun yarn tied in hanks graded to proper size for warp and weft, all ready to be made into similar blankets, and a spindle whorl are proof enough that he had been a weaver.

For further information concerning the Weaver, pottery gives the principal clues. Pottery vessels, even fragments of them, are as significant to an archaeologist as are the marked cards of a deck to a gambler. He studies the wares

found in the area he is investigating until he is thoroughly familiar with their distinguishing peculiarities, such as shape, color, thickness, surface finish, and kind and character of decoration. Moreover, from a study of refuse dumps, where the oldest kinds of pottery are in the bottom layers and the most recent in the top, he knows the relative ages of the types almost as well as if they were arranged like the pages of a book.

The large jar and three of the bowls buried with the Weaver are typical Mesa Verde ware. The fifth vessel, the red one, is of a ware current about a century earlier—an heirloom kept so long that the bottom had been worn almost through. The ruin nearest to the Weaver's tomb, Antelope House, just across the Canyon, was not his home, because in the pottery fragments scattered about that ancient village, there are none of Mesa Verde ware. However, in a branch canyon, half a mile or so upstream, there is the wreckage of a large valley-bottom dwelling where Mesa Verde pottery is the most prevalent kind. There is small doubt that in one of the rooms of that dwelling, the Weaver hung his loom and that from there his funeral cortege bore him to the crypt upon which Oscar had so fortunately blundered.

Mesa Verde pottery is so named because it is the kind of decorated ware made by the last occupants of Cliff Palace, Spruce Tree House, and the other great cliff dwellings in what is now Mesa Verde National Park. Canyon del Muerto is about 100 miles as the crow flies south-southwest from Mesa Verde. What is Mesa Verde pottery doing in Canyon del Muerto?

### Climatic Change

During the last quarter of the thirteenth century, there was a great disturbance of rainfall in the San Juan country, which most frequently is interpreted as a 23-year drought. In that interval the people became much reduced in number as a result, presumably, of famine, pestilence, and attendant calamities. Eventually the survivors drifted

away in small groups to places where there was greater hope that crops could still be produced. Canyon del Muerto was one of the best watered spots in the entire region. To it came some of the Mesa Verde emigrants to establish new homes. Naturally they went right on making and decorating their pottery as they had done in the past.

### Dating by Tree Rings

The approximate time of their arrival is definitely suggested by the most pretentious dwelling they erected in the Canyon—the Tower House of Mummy Cave. A study of the annual growth rings in the ceiling timbers of the Tower has shown that most of them were cut in the year A.D. 1284. This date falls in the middle of the great drought and is a logical one for the coming of the Mesa Verde people to del Muerto. The move gave a brief but not a permanent respite from the besetting difficulties, because by 1350 at the latest, the native Pueblo groups in del Muerto, as well as their immigrant kinsmen, had departed, never to return.

The Weaver was old at the time of his death. It may well be that he was among the very ones who made the long trek from Mesa Verde, their few possessions on their backs, in search of a Promised Land where threat of hunger would no longer haunt. To judge, again, from the wealth of his burial accompaniments, he died before del Muerto was, in turn, becoming untenable. It may be said without much risk of error that his burial took place between A.D. 1285 and 1325.

If seeing, but unseen, the Weaver watched us rout what had been his earthly form from the crypt where it had lain wrapped about with darkness for more than six centuries, consternation must have gripped him. However, one can but hope that in the end he came to regard the new resting place that was prepared for his body and burial gifts as a not unfair exchange. It is a carefully sealed glass case in The American Museum of Natural History, New York City.

# An Impending **FOREST DISASTER**

The world's most magnificent pine trees are to be logged

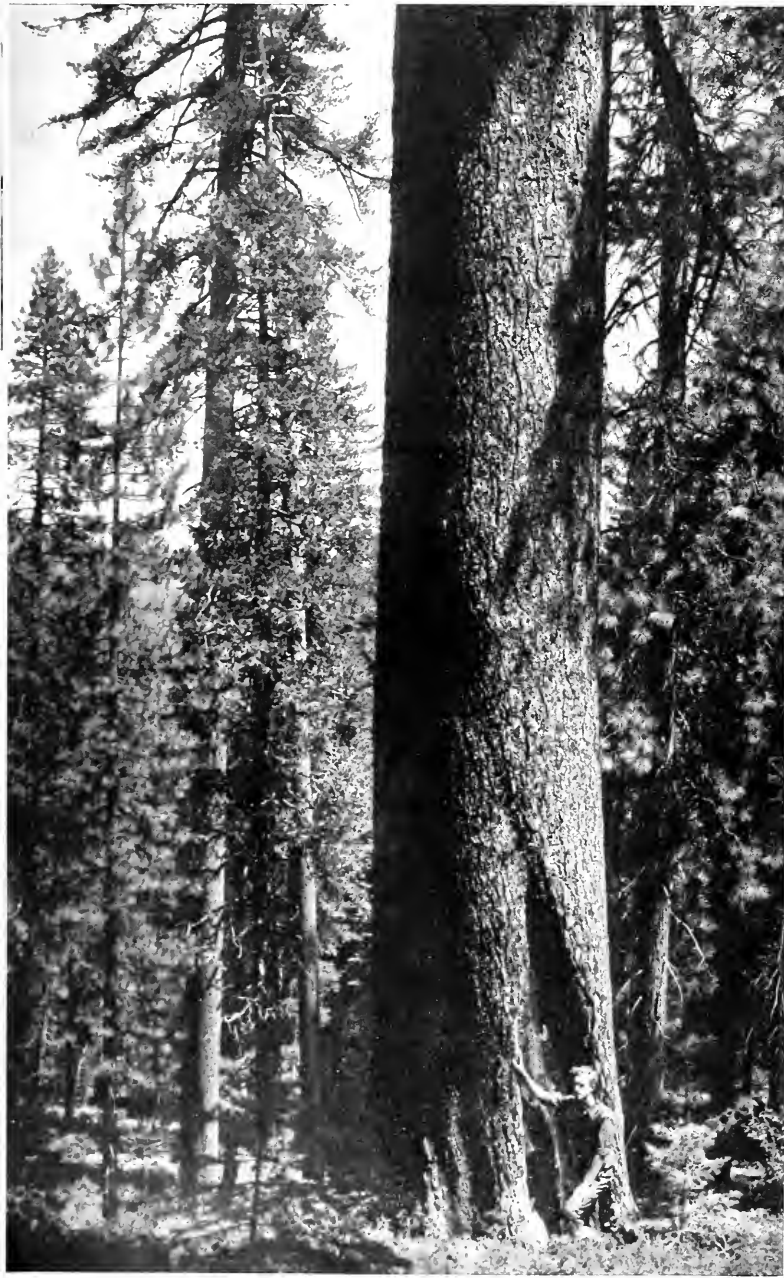
By WILLARD G. VAN NAME

THE very unusual conformation of the terrain on the lower slopes of the Sierras in the northwest part of Tuolumne County, California, has resulted in the preservation up to the present moment of a very few thousand acres of forest so remarkable that it does not seem an exaggeration to call it the most unique and beautiful primeval tract of equal extent in the whole United States. In saying this, it does not seem necessary to make exceptions of areas now in the national parks, for this tract is of outstanding national park character in impressiveness and beauty.

In 1941, when I rode through this area, which is readily accessible only on horseback, I was astonished to find that such trees still existed, especially so near the big cities of central California. I had expected to see some fine trees, but when I found myself scarcely pausing to look at a Sugar Pine less than six or eight feet in diameter, I knew that here was indeed a unique forest. In addition, the country surrounding the Gorge of the Stanislaus River is extremely beautiful.

But my determination to make every possible effort to arouse interest and secure the preservation of this tract has failed. Commercial and political influences have imposed an almost completely effective taboo against even mentioning this remarkable area. Not a single conservation agency or private organization, and not one scientific society in the state has yet taken any action to call public attention to it. The general public has been kept almost entirely ignorant of its importance.

What has saved this magnificent region until now is the wide and deep gorge of the North Fork of the Stanislaus River, which is not bridged in the immediate neighbor-



*Photo by Willard G. Van Name*

▲ A SUGAR PINE in Tuolumne County, California. The gash near the base is not decay but an old fire scar that is healing

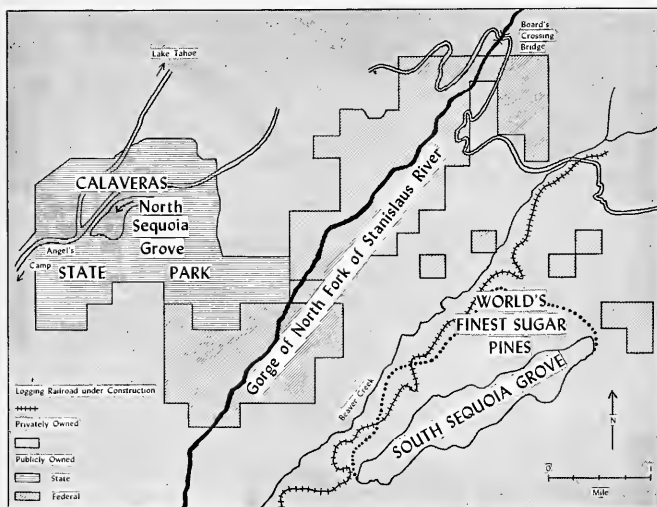
hood. This has made the rugged area on its eastern side difficult to reach and has kept it uninhabited and without roads. It is, therefore, visited by few people.

Its isolation has kept out the logging crews, but it has also made it possible to keep the public practically ignorant of the fact that this small area contains the largest and most magnificent pines in the world. There are Sugar Pines 8 feet or more in diameter and from 200 to 240 feet tall. There are also Ponderosa Pines that are not much smaller. This area is 60-odd miles from Stockton and Sacramento and less than 120 from San Francisco.

Should not these trees be preserved? No such stands exist in any national park; they are far more magnificent than the pitifully small remnant of John Muir's famous forest that Yosemite Park has been permitted to preserve.

The isolation and safety of this tract has now come to an end, and its destruction will begin in earnest this spring. For years a logging railroad has been eating its way toward these trees and has now practically reached its objective. This summer an endless procession of logging trains, every car carrying one or more enormous logs, will be rolling down to the lumber company's mill near Sonora.

▼ THE CALAVERAS REGION showing the finest Sugar Pine area. Note large proportion of land already publicly owned



The loss will be an irreparable one not only to California but to the whole nation, for a region like this is of interest and importance to every citizen of our country. It would take 600 to 800 years or more to restore such a forest.

This remarkable region also contains the splendid South Calaveras Grove of Giant Sequoias, one of the largest and finest groves of these trees. That this ought to be acquired and preserved goes without saying. Everybody agrees that it should, and there is reason to hope that its preservation may eventually be secured, though its owners are at present holding it at an entirely prohibitive value. Even though it is a difficult section to reach, there has been enough publicity about this grove to create a demand that it be saved. But hardly anybody even knows of the existence of the Sugar Pines, whose preservation is even more important, as few large ones are being saved anywhere.

The Sequoia Grove is not the immediately urgent problem. The sequoias can wait. Nobody wishes to destroy them now, and the lumber company that owns or controls all the timber in the region is in far more haste to liquidate the big pines, firs, and cedars. The wood of the sequoias, unlike that of the coast redwoods, is soft, brittle, and of

inferior value. It would probably be more profitable to sell the grove for park purposes.

In 1945, an investigation of this region was made for the state by Mr. Frederick Law Olmsted, the well-known landscape architect. His report urged the preservation not only of the South Sequoia Grove but of a considerable area adjacent to it on the north, in order to save the finest stands of the big pines. This latter area is on the slopes to the east of Beaver Creek and is more or less in a direct line between the South Calaveras Grove and the region that is already a state park.

It was made public that Mr. Olmsted's report had been approved and that the state would provide the usual fifty per cent of the cost necessary to carry it out. Lately it has come out that what the state officials approved was a "revised" report "made after further investigation," which would save nothing but the sequoia grove surrounded by a narrow covering belt of forest, a large part of which would be selectively logged. Of course, the big pines there will be among the trees selected to be cut.

Thus there is no hope for any of these wonderful Sugar Pines except for some that may be standing among the sequoias, assuming that the Sequoia Grove will eventually be saved.

Is there nothing that can still be done? Letters of appeal to Governor Earl Warren at Sacramento would seem to be the last desperate expedient. He has expressed a personal interest in the matter. Letters should ask that the magnificent stands of Sugar Pines north of the South Calaveras Grove, whose preservation was recommended in the 1945 report of Mr. Frederick L. Olmsted to the Division of Beaches and Parks should be acquired and preserved, not merely the sequoia area, which as stated above is not in immediate danger.

Do not imagine that this is the affair of the citizens of California only. It is a matter of concern to every nature lover in every state. It will be an irreparable loss to the American people of today and of the future.



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**BOOKS**

*Continued from page 54*

able and well documented ever devoted to a breed. He describes the horse in Arabia, where he, himself, saw it while seeking stock in the desert. A historical background is sketched in, and related breeds are discussed. Strains and families in Arabia are exhaustively listed in both English and Arabic. The characteristics of the breed are thoroughly expounded, and performance records are given. The author has also made a valiant effort to substitute sounder information for traditional stablelore on horse breeding and heredity, although he has not quite freed himself from ancient misconceptions and sometimes goes astray in presenting modern knowledge, as when he makes the astonishing assertion that "inbreeding reduces the number of gametes." ("Gametes" are not defined, and the author surely does not know what the word means.) Such errors are few, however.

The book is large and handsome and will be prized by anyone interested in horses.

G. G. SIMPSON.

**THE SIERRA NEVADA:  
THE RANGE OF LIGHT**

- - - Edited by Roderick Peattie

The Vanguard Press, Inc., \$4.50  
388 pp., 26 illus.

**F**IRST seen by Spanish missionaries four years earlier, the greatest mountain range in California was placed on a map by Pedro Font in 1776. Little effort was made by the early Spanish settlers to explore the range, however, and it was an American, Jedediah Smith, who first crossed the Sierra in 1827. With the discovery of gold in 1849, as everyone knows, Americans poured into California and into the Sierra foothills. The famed Yosemite Valley was discovered and publicized at an early date, with a party of sight-seers entering the Valley in 1855.

Finally there came the geologists, mountaineers, botanists, naturalists—and with roads, the sports enthusiasts. Ten chapters in this account of the Sierra Nevada have been prepared by experts in these various fields, all of them with vast firsthand knowledge of the region. Weldon Heald reminds us that "The High Sierra is a wilderness only by courtesy. To keep it that way constant alertness is necessary, backed by acts of Congress and elaborate laws." Power and timber interests have been a constant threat since almost as long ago as the advent of the Forty-niners—and they remain so. Chapters dealing with the geology, the history, mountaineering, climate, and winter sports are absorbing factual accounts. Although a slim chapter is devoted to birds, little if anything is said about other animals. A more balanced treatment would have included

more zoological and less botanical information. Nonetheless, visitors of the future, as well as the past, will read this book with delight. The chapter, "A Geologist's View," by François E. Matthes is particularly well done, and you do not have to be a "rock climber" to appreciate Oliver Kehrlein's description of mountaineering achievements, climaxed by his thrilling account of the ascent of "Lost Arrow," the "needle" of the Yosemite.

C. M. BOGERT.

**WORLD'S GREAT STORIES  
OF HUNTING AND ADVENTURE**

- - Edited by Bradley Robinson  
Robert M. McBride Co., \$3.75  
384 pp.

**I**N general, the stories in this book by Bradley Robinson are interesting, give trustworthy factual statements, and avoid the sensational and emotional window dressing so often associated with narration in these categories. Many of his chapters are taken from books that are classics in their field. They have a wide coverage in time and space, and the reader can contrast the significant advances in present-day techniques with the primitive circumstances confronting pioneer hunters and explorers.

As would be expected, most of the book is devoted to stories about hunting dangerous big game. With few exceptions, these accounts tell of hunters risking their lives to shoot or photograph a powerful animal. The elements of fair chase are present, courage is displayed, and, in many cases, man-eaters are eliminated. The hunting stories are frankly selected for readers who expect animals to be killed.

But even for readers whose primary interest in mammals is from the angle of the chase, there are several instances of game butchery that, in the opinion of this reviewer, should have been left out of the book, unless they were cited as examples to be deplored. This the editor fails to do in his introductory preface to each chapter.

There can be no question as to the reputation of Selous as an intrepid big game hunter. Also he probably did only what others of that period did. Nevertheless, I would not characterize as a "great" hunting story his chapter "An Elephant Hunt." Too many dead and wounded elephants for one day's ruthless work to make this a "great" exploit.

Similarly, Charles J. Andersson's statement of rhinoceros hunting, "One night, indeed, when quite alone, I killed in the space of five hours no less than eight of those beasts . . ." would seem to most persons something to be forgotten rather than publicized.

H. E. ANTHONY.



## HOW FLIES FLY

Continued from page 63

become as prominent as the halteres of many flies.

I think there is little doubt that the halteres of flies developed as a compensation for the loss of wings and to satisfy the need for rapid flight, either to escape enemies or to overtake possible prey, since many flies pursue other insects as food or are parasitic upon other forms of animal life.

### What Does It Mean?

These first highly magnified, clear

pictures of a fly in slow motion at last show us the angles at which the wings move and demonstrate that the fly performs no wasted motions. Further studies may lead us to the discovery of new principles and designs useful in aerodynamics. We are also able to observe external movements of flight that indicate the movement of internal mechanisms, the future study of which will doubtless result in the improvement of many mechanical devices. The manner in which the fly achieves efficiency through the flexibility of the wing may give us new ideas about reduction of air drag. And that some of our fastest fliers do not

comply with the current standards of streamlining may lead to revision of some of our ideas in this important phase of aerodynamics.

Further studies will require improved methods of photography, with cooler lights, lenses giving higher magnifications, better techniques in handling flies—and endless patience. These things are receiving much thought at the present time, and Mr. Lester and I expect to continue our researches in the hope of producing pictures that will show in greater detail the secrets of the creatures that have achieved the most efficient methods of flying.

## LETTERS

Continued from page 53

Mrs. Albert H. Kelly of 7 Bar 9 Ranch, Cascade, Montana, who in turn passes them on to the Deaconess School at Helena, Montana, where her son is at school. So you can see how many people enjoy and appreciate every copy of your splendid magazine.

(Mrs.) JOSEPHINE M. HOLLINGSWORTH.  
Scotch Plains, N. J.

SIRS: . . .

. . . I give my copy of NATURAL HISTORY to my niece here in London, Ontario; she hands it over to her brother, who also lives here; he in turn mails it to another niece living in South Australia; and she mails it to Crosbie Morrison, the editor of *Wild Life* at Melbourne.

A letter recently received from Mr. Morrison by my niece reads: "Many thanks indeed for your kindness in sending further copies of NATURAL HISTORY. They are always very welcome. I find that I derive a lot of benefit from them, both in natural history notes and in modern methods of magazine presentation. After I have finished with them, they are passed on to various schools, and so they certainly do a very good job."

J. E. KEAYS.

London, Ont.

SIRS: . . .

I thought two years ago your magazine could not be improved. Now I know I was wrong. It's a superb bit of a publication. Each number is better than the previous one. EUGENE C. SAMPSEN.  
Spokane, Wash.

### Erratum

Owing to a typographic error, the title of the article on page 8 of the January issue should obviously have been "Reminiscences of a Cinchona Hunter" instead of "Reminiscences of a Chichona Hunter."

## Quick-Change

By MABEL IRENE HUGGINS

With hummingbird speed you can change all of these birds and animals into plants by adding a single word after each—the very same word after every one! What is that word?

centipede  
crab  
bird  
buzzard  
canary  
cockatoo  
duck  
goose  
guinea  
penguin  
pigeon

rattlesnake  
chameleon  
mouse  
hedgehog  
porcupine  
squirrel  
wallaby  
kangaroo  
dog  
fox  
deer

goat  
bear  
tiger  
buffalo  
elephant  
bull  
zebra  
pony  
bronco  
racehorse  
camel

The answer is on page 96

## BIOLOGICAL STATIONS

### The New Lerner Marine Laboratory

The establishment of a marine research center on the island of Bimini in the Bahamas was announced recently by Dr. A. E. Parr, Director of the American

Museum of Natural History. The new field base, now nearing completion, is to be called the Lerner Marine Laboratory for its founder, Michael Lerner, prominent naturalist and member of the Museum's Board of Trustees. Its primary purpose is to further the studies of the



Museum's Department of Fishes and Aquatic Biology. Opportunity will be afforded, however, for research in related fields by scientists from other leading institutions. The laboratory will be under the direction of the Department's chairman, Dr. C. M. Breder, Jr.

"Bimini was selected by Mr. Lerner after two years of survey," Dr. Parr said today. "Its research advantages are many. Within a mile of the laboratories are to be found coral sand beaches with outcrops of aeolian limestone, a large, nearly landlocked lagoon, a harbor of some depth, a salt pond, mangrove tangles, the Grand Bahama Banks with their reaches of salt-water flats, beds of living coral and sea fans, extensive reefs, Gulf Stream waters at a point of peak flow, and oceanic depths.

"The Museum's new station will be the only one of its kind permanently operated by such an institution. Museum research projects have been undertaken during the construction period, and papers now await publication on the behavior and pigmentation of shore fishes and on fish parasitism. Mr. Lerner has not only made a gift of the base but has also established a fund, in which others have participated, for its maintenance, thus assuring year-round opportunity for many varied projects. The first of these will be the collection and identification of native fishes, marine invertebrates, and marine plants. Studies will then be made of their resident, transient, or accidental occurrence, abundance centers, and so on, followed by broader ecological research, behavior and social studies, and a host of other investigations."

The base for these explorations, which are expected to solve many ocean mysteries, is provided with a library-study, a large general laboratory, a small laboratory for microscopic work, a darkroom for photographic and biological operations, and a large aquarium room for research on living organisms. This aquarium is served by a nonmetallic sea-water pumping system, an important adjunct of marine biological studies.

The research center includes a residence for the permanent staff and visiting scientists, storage space, and a powerhouse with both wind and gasoline generators. Large and small boats equipped for observation and collection will be available to the scientists, as well as diving helmets, concrete pools with running sea water, batteries of small aquaria, and a laboratory water table.

## SEA AND LAND SHELLS

If you are a buyer of this class of invertebrates send for my Conchological Chatter which appears monthly listing choice Mollusca from every part of the world. Collections for sale of any size up to 5000 species. Also Books on Mollusca.

WALTER F. WEBB

2515 Second Ave. North, St. Petersburg 6, Fla.

Two large stockades have been constructed in the sea itself for close, controlled study of the larger forms of marine life. In one of these enclosures, which is 122 feet long, sharks and barracuda are now under observation.

Bimini, a British possession, requires no passport. The island lies some 50 miles due east of Miami, Florida, and is served by regular boat from Miami and Nassau, as well as by air. The new Lerner Marine Laboratory will be operated by the Department of Fishes and Aquatic Biology of the American Museum. A special committee, consisting of Mr. Lerner, Dr. Breder, Philip Wylie, the author, and Arthur Gray of New York, has been appointed to serve the station in an advisory capacity.

## Archbold Biological Station

Since its establishment in 1941, the Archbold Biological Station has carried on a variety of research projects in biology. It is directed by Richard Archbold and financed by him through Archbold Expeditions, a non-profit corporation affiliated with the American Museum of Natural History. The facilities of this Station are open to workers in any field of zoological, botanical, ecological, and anthropological research who may be approved by the Advisory Board. First consideration is naturally given to individuals whose programs can best be carried out in this particular region and under the conditions afforded by the Station.

The Station is situated in south-central Florida, approximately 20 miles north-

## Answer to Quick-Change Quiz Grass

No doubt you are familiar with crab grass. And buffalo grass is well-known throughout the areas that were formerly the feeding grounds of the American bison. But perhaps some of these other grasses are less common—rattlesnake grass, hedgehog grass, elephant grass, kangaroo grass, zebra grass, etc.

west of Lake Okeechobee, accessible to five of the ten physiographic regions of southern Florida. This location fits the Station first and foremost for work in terrestrial and fresh-water biology, although it has been used as a base for wide-range fieldwork involving both the west and east coasts of Florida. The property that serves as Station headquarters is 1050 acres in extent and is situated near the southern end of the sandridge and lake region eight miles south of the town of Lake Placid.

## EXPEDITION EQUIPMENT

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In addition to living quarters, the main building contains seven work units, each 40 feet square. Biological and chemical laboratories, photographic facilities, and a machine and carpenters' shop are included in order to render the establishment self-sufficient in meeting the requirements of a wide variety of research projects. There is also a study collection of local birds and mammals, a local herbarium, and a seed collection. A small library contains a card-indexed collection of scientific publications of Florida.

To cover living and other expenses, visiting workers are charged a fee of \$50.00 a month, which includes board and lodging, the use of laboratories and work space, local transportation, and ordinary assistance. Long-distance transportation and unusual expenses of labor and materials may incur additional charges. The existing basic fee may be revised at the discretion of the Advisory Board, and special consideration may be given to cost relationships in the case of individuals whose work is being carried out on a very limited budget. No charges are made to staff members of the American Museum of Natural History.

NATURAL HISTORY Magazine hopes to keep readers posted on the activities of this unusual biological station. Meanwhile, persons interested in obtaining further details regarding its facilities and the type of biological research for which it is best fitted are referred to a prospectus which can be obtained from the office of the Archbold Expeditions at the American Museum of Natural History.

## Join THE NATURAL HISTORY BOOK CLUB

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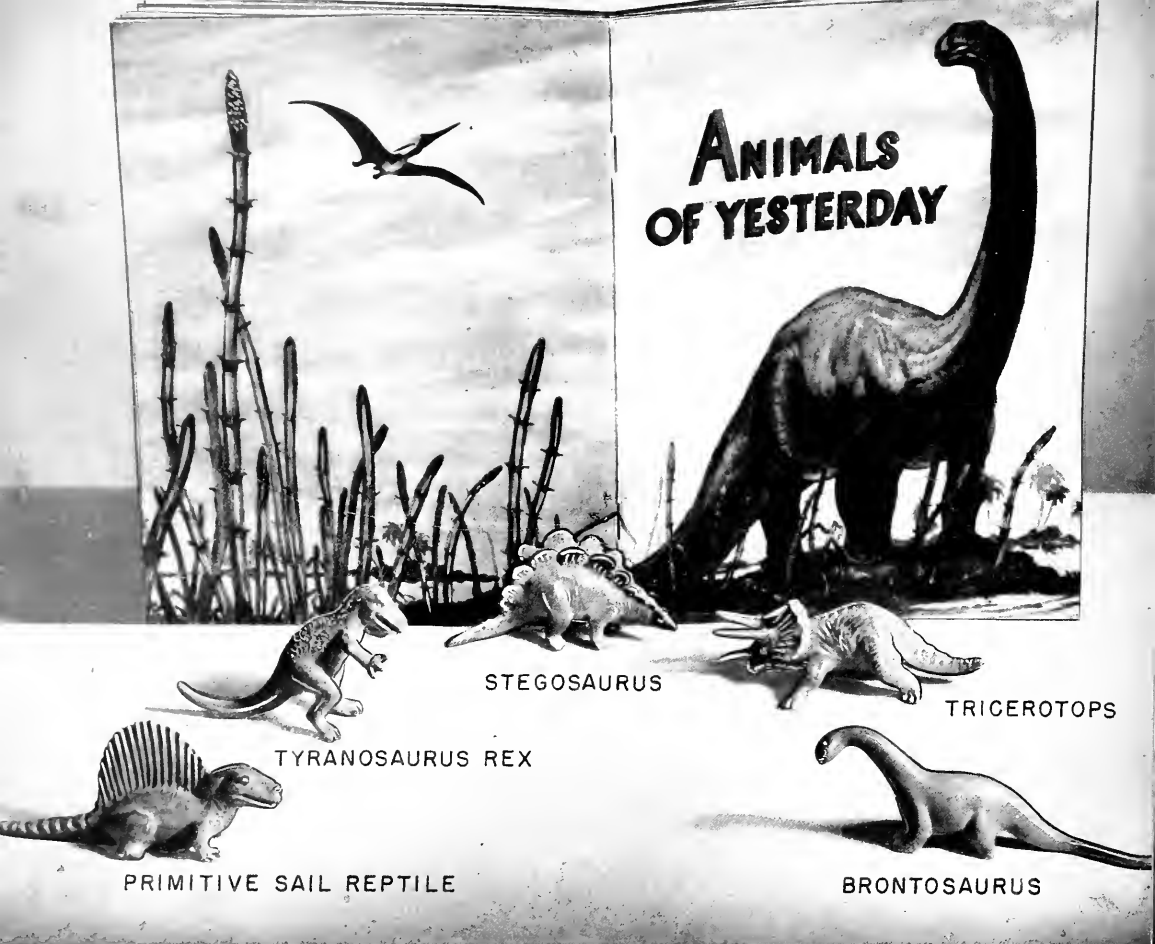


*March* **NATURAL HISTORY** 1948

*Meet the Curator • Giant Fly • Brains and the Beast*

*Ben East • Timber-Line Trails • Wildlife Sketches*

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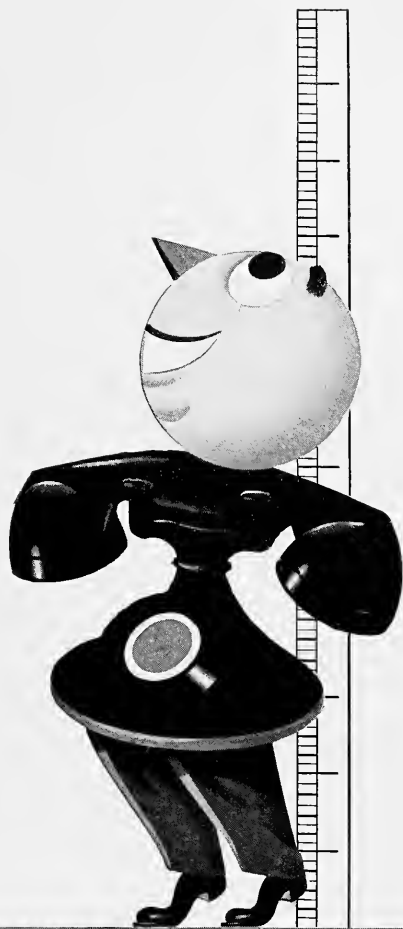
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BELL TELEPHONE SYSTEM





Two remarkable photographs by John E. Davis of Berkeley, California, showing the work of woodpeckers in providing a future food supply



## **Acorn Hoard**

Sirs:

Your readers may be interested in the peculiar sight of a telephone pole that has been filled with acorns by California woodpeckers. Watching the birds at work, I noticed that they first drilled a hole and then went and got an acorn and put it in place. The holes were tapered, so that the acorns, nearly two inches long, fitted quite tightly into them.

The pictures were taken in the month of October. When I returned a little less than a year later, I found that most of the acorns had been removed or broken. Almost without exception the acorns were wormy or contained residual matter, indicating that they had been wormy, so I am sure the birds eat the grubs as much as they do the nuts.

I am told that the holes are more often drilled in the bark of trees but that poles are sometimes used when suitable trees are scarce and possibly at other times as well.

JOHN E. DAVIS.

Berkeley, Calif.

## **Predatory Squirrel**

Sirs:

Until a few days ago, I did not know that the squirrel can be carnivorous. Two members of my household watched one seize a sparrow, carry it swiftly up a tree, and devour it. Though I did not witness the tragedy, I verified the facts from the evidence of feathers, bits of torn flesh, and spots of undried blood.

Is such a happening out of the ordinary? No doubt the little rascal was desperate for food under the existing conditions, but in any case, he was a fast worker. By the time I was called, only a few moments after the event, the squirrel had vanished, leaving a scattered array of downy breast feathers, a piece of the sparrow's head, and one whole wing hanging forlornly from a lower tree branch.

(Rev.) JOHN NER BORTON.

Newark, N. J.

The following answer is offered by T. Donald Carter of the American Museum's Department of Mammals:

It is a well-known fact that most rodents are at times carnivorous, some more often than others, and squirrels are no exception. The Eastern Gray Squirrel has frequently been observed in the act of robbing a bird's nest, but its record is not nearly so black as the Red Squirrel's. Nest robbing appears to be a matter of the individual animal's taste. Gray and even Red Squirrels may be common in the same locality with nesting birds, and the nests go undisturbed.

*Continued on page 100*

NATURAL HISTORY, MARCH, 1948

# NATURAL HISTORY

*The Magazine of the American Museum of Natural History*

FREDERICK TRUBEE DAVIDSON, President

ALBERT E. PARR, Director

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## THE COVER THIS MONTH

The Common or Bull Thistle, *Cirsium lanceolatum* (L.), is a species of thistle native to Europe and western Asia. It flowers in late summer and early autumn and is numerous in pastures and along roadsides. The purplish flowers are tubular and are seated in a pitted and hairy receptacle. Its prickly leaves and the rapidity with which it produces seed and spreads its roots make this beautiful plant a weed that is difficult to uproot and a nuisance to farmers.

*Cirsium*, a genus of some 200 species, is derived in name from a Greek word meaning "a swelled vein," for which the thistle was once believed a remedy. Numerous species other than the Bull Thistle are still used for medicinal purposes.

The Bull Thistle is usually accorded the distinction of being the thistle from which Scotland's heraldic and national emblem was modeled, although this honor is sometimes bestowed on other species. Reverence for the thistle flower in Scotland is also exemplified in the "most ancient" Order of the Thistle, founded in 1687 by James II. It is now conferred on sixteen Scottish nobles, besides royalty. The insigne consists of an eight-pointed star containing a cross, a figure of St. Andrew, and a thistle flower.

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EDITOR: Edward M. Weyer, Jr., Ph.D.  
Elizabeth Downes, *Editorial Assistant*.  
Atherlie E. Karp, *Editorial Assistant*.

ART AND PRODUCTION: Robert E. Williamson,  
Jean Bruck, *Assistant in Art and Production*.

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*The American Museum is open to the public every day in the year without charge*



◀ A MEDIUM-SIZED *Nereis virens*, six inches long, photographed near Bar Harbor, Maine. Near by is seen a casting left by the worm in burrowing. *Nereis* has paddles on the sides of its body which create a breathing current of water and help propel it toward its mate at the time of synchronized swarming

swim upward, and rush about in great numbers. Each worm moves in a spiral course, tangential to the surface and just below it. The pond seems filled with them.

By the hour their numbers grow, and biologists gather to watch the fun. Fish dart in to take a toll, but more *Nereis* fill the gaps. At last the dark green females appear, swimming in straight lines, rising obliquely from the water's depths to join the males at the surface. Their mates sense their coming and swim faster and faster in tighter spirals. Those near each female double or treble their speed. Finally, closely around the body of each female, a male swims his spiral. Over her, then under her, he goes. As he brushes past, the water about the pair clouds with gray. The seemingly oblivious female reacts at once and in a most amazing way. She explodes. Through rents in every segment, millions of tiny eggs pour into the haze of sperm. She becomes a transparent, almost colorless bag of skin, which collapses and sinks slowly to the bottom of the sea to die within a few hours.

The males swim on, but before dawn they, too, drop down through the water to die. The low tide under the rising sun does not show a trace of *Nereis*. It's very sad but also very wonderful, for the eggs sink slowly through the water to become the next crop of worms.

In Maine mudflats there are larger clam worms, *Nereis virens*, eight to twelve inches long. They differ from the Bay State sort also in being much harder. They not only thrive in the chilly waters along the coast but select February and March for their mating swarms. As the sea temperature rises to a mere 38 degrees Fahrenheit, these worms emerge from the bottom at high tide in full day-

## LETTERS

Continued from page 98

The Red Squirrel has a reputation of being a confirmed nest robber, and it does destroy many nests. However, not all Red Squirrels will rob a nest when the opportunity presents itself, as many persons would lead us to believe. Two years ago last summer, a pair of Red Squirrels made their home in a shed on my property. On a beam of the same shed, a pair of Phoebe had built their nest. The squirrels passed within two feet of the nest many times a day on their way to and from their home, but in spite of this, the Phoebe successfully raised two broods.

The Flying Squirrel has also been known to kill and eat nestlings, chiefly those living in cavities, bird boxes, and houses. An Eastern Chipmunk was observed to catch, kill, and partly eat a Junco at a feeding station. The Ground Squirrels of our central and western states are known to catch and eat young chickens.

In Alberta, a trapper once told me that both the Flying and the Red Squirrels were very troublesome along his trap-

line, for they were continually getting into his traps, attracted by the meat he was using as bait for the larger carnivora.

## Clam Worms

SIRS:

"Breeding and the Sun and Moon," in the January NATURAL HISTORY, covers a most fascinating subject. We wish that Dr. Berrill had found space to mention two sea worms found along New England shores that respond to the beck of the moon. They can be seen by many who cannot get to Samoa to see the palolo.

One of them, *Nereis dumerilli*, is almost a pet in the Eel Pond behind the Marine Biological Laboratory at Woods Hole on Cape Cod, Massachusetts. It is common all along that coast; but from the basement laboratories there every summer, the students run long extension power cords out on the floating wharves and set gooseneck lamps on the edge so the light can shine on the water a foot or so distant. Five days after the new moon nearest the summer solstice, if the water is calm as the tide approaches its midnight flood stage, the brownish-red to yellowish-pink males leave the bottom,

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## IN FREAKDOM—

THE PALM AND THE PINE  
CAN APPEAR BROTHERS  
UNDER THE BARK

*Some sort of damage in youth probably  
produced these similar oddities*



▲ A LYRE-SHAPED PINE, growing in the Feather River region of Plumas County, California. Photo by Helen Faye

◀ A FOUR-HEADED CABBAGE PALMETTO, transplanted from the Florida wilds to residential grounds in Orlando. Photo by Hugo H. Schroder

light. For a few hours each day, over a period of nearly three weeks, they are abundant. Thousands of dead green bodies float in and out with the waves, while even larger numbers perish in explosive ecstasy.

Maine fishermen make a tidy sum each year by selling these amazing worms for fish bait, but by experience they know that the mature worms break easily and are unsuitable for shipment. The worm collectors take a rest during the swarming period and the few weeks preceding it. They recognize the spawning worms by their color and by the way the body contents flow to one end when the animal is held vertically. Collectors have found that with the eggs and sperm there is a potent chemical filling these adult *Nereis*. It is so strong that if one preg-

nant worm is broken in the presence of 100 healthy, immature individuals, all will perish in a few hours. Only when diluted by the sea is the substance harmless. Perhaps this is the far-reaching lure that draws related clam worms from the mud for their synchronized swarming. But without the stimulus of sun and tide, the first worm wouldn't come. So the story is back to where Dr. Berrill left it!

LORUS J. and MARGERY J. MILNE.  
University of Vermont,  
Burlington, Vt.

### Fang in Boot Story

Sirs:

As an instructor in science in high school, I find *NATURAL HISTORY Magazine* very informative and interesting. I would therefore appreciate word from

you concerning the possibility of snake fangs imbedded in a leather boot causing several wearers of the boot to be poisoned. No matter what I say about the falsity of this story, there are still "die-hards" in my classes who refuse to give it up . . .

J. E. H.

Eugene, Ore.

The following answer is given by Charles M. Bogert of the American Museum's Department of Reptiles and Amphibians:

The story of the fang in the boot that killed successive wearers is so well imbedded in American folklore that it is not astonishing to find students who cherish the belief. The yarn formed the basis of an extremely well-written story.

*Continued on page 142*

# YOUR NEW BOOKS

MEXICO • WEATHER OBSERVING • CAMPING  
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## THESE ARE THE MEXICANS

----- by Herbert Cerwin

Reynal and Hitchcock, \$5.00  
384 pp., 32 plates

IT is obvious that the author of this book knows a great deal about Mexico, its people and its history, and he has presented a well-rounded and understanding view of many aspects of the Mexican character, customs, and institutions. He necessarily touches on much of the same ground that has been covered in many other recent books on Mexico but with a fresh point of view and with a frankness that is unusual. The author was head of the Mexican Office of the Coordinator of Inter-American Affairs and in charge of United States propaganda during the recent war.

*These Are the Mexicans* is an attempt to explain the Mexican—his method of thought, his social life, and his politics. By showing these aspects of life he makes the Mexican and Mexico understandable to the people of the United States. The chapters of the book are each devoted to a single phase of the Mexican scene, such as the schools and education, food, the church, graft in politics, and the significance of having the powerful United States as a next-door neighbor. In an unbiased matter-of-fact way, he draws together a great amount of miscellaneous information which cannot be found elsewhere in quite the same form.

I find it a valuable book and recommend it both to those who know Mexico well and to those who want an introduction to Mexican ways.

GORDON F. EKHOLM.

## TECHNIQUES OF OBSERVING THE WEATHER

----- by B. C. Haynes

John Wiley and Sons, \$4.00  
272 pp., 98 figs.

THOSE who are interested in the weather and the meteorological phenomena that accompany changes in it will welcome *Techniques of Observing the Weather* by B. C. Haynes, Chief of the U. S. Weather Bureau's Observations Section. Airplane pilots, civilian as well as military, remember B. C. Haynes as the author of their standard text *Meteorology for Pilots* (C.A.A. Bulletin No. 25). Those who followed the U. S. Navy's recent Antarctic expedition will recall that he was Admiral Byrd's Weather Bureau meteorologist. While the title of this book sounds technical, the author has achieved nontechnical simplicity in presenting scientific facts.

This book is extremely well organized and is logical in its presentation.

Meteorology deals with our atmosphere and its phenomena. Thus, meteorological observations include the recognition, measurement, and recording of what are known in the broad sense as "meteors." The author classes these as follows: (a) aerial meteors, such as winds and tornadoes; (b) hydrometeors, such as rain, hail, and snow; (c) lithometeors, such as dust and smoke; (d) luminous meteors, such as rainbows and halos. The latter also include the igneous meteors, lightning and "shooting stars." The subject of visual observations is covered not only by a clear explanation of how the various types of clouds may be identified but

also by excellent photographs of them. The standard symbols used in weather recording are given, as well as the physical properties of each type of cloud.

The more technical side of meteorology having to do with modern meteorological instruments and their use is also dealt with. The simpler mathematical relationships and conversions that the meteorologist must make are explained. Some of these formulas are arithmetic and some trigonometric. Their use is simplified by tables in an Appendix. Work sheets are included for practice.

Liberal use is made of photographs and detailed drawings to explain the use and functions of observing instruments, old as well as new. Starting with the rain gauge, the oldest of meteorological instruments, "dated about A.D. 1442" (by the Koreans), each observing instrument is described, up to the latest ones like radiosonde and its companion unit rawinsonde.

The meteorological instruments used by the U. S. Weather Bureau are very expensive. Examination of Chapter XIII, "An Improvised Weather Station," will reveal how it is possible to construct very serviceable instruments cheaply and easily. This should appeal to the amateur observer as well as to schools and amateur societies. This book places scientific weather observing within the means and skills of the average man.

GORDON A. ATWATER.

## REPTILES AND AMPHIBIANS OF THE NORTHEASTERN STATES

----- by Roger Conant

Zoological Society of Philadelphia, \$1.00  
41 pp., 123 illstrs.

THIS is a well-illustrated "non-technical résumé of the snakes, lizards, turtles, frogs, toads, and salamanders" inhabiting an area from Maine to Maryland, including the eastern portions of New York and Pennsylvania. The introduction provides a brief orientation for the beginner, followed by a check list of all forms, together with their known geographic distributions. The remainder of the pamphlet consists of separate sections treating 27 snakes, 6 lizards, 16 turtles, 20 frogs, and 18 salamanders inhabiting the Northeast. The treatment of snake bite and the care of captive specimens are

*Continued on page 140*

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▲ A STORMY DAY in Kearsarge Pass, 11,823 feet above sea level, about seven miles north of Sequoia National Park, California. One sometimes wonders how the trails could have been built through such a maze of sheer and fallen rocks



◀ CROSSING STREAMS swollen by rain and melting snow is a ticklish business when the logs are wet and slippery

## A journey afoot in the wonder world behind the High Sierra

**I**F you have driven through Owens Valley in eastern California, you have undoubtedly marveled at the towering, jagged line of peaks that rims the valley on the western side, climaxed by Mt. Whitney, the highest point in the United States. As you look up at this procession of pinnacles and crags, you'll agree that the Spanish explorers did well to call this range the Sierra, or "saw." And if you are psychologically chained to your automobile, the other side of those mountains will remain as inaccessible and mysterious as the other side

of the moon, because no roadway takes you within view of it from the western side. You have seen Mt. Whitney, so you buy a postal card. You have slept at the foot of Shangri-La without knowing it was there.

Or if you did feel curious and dreamed a bit about what lay beyond, perhaps it seemed unattainable. It did to us the first time we thought about it, but the idea grew, and we decided to find out. We discovered that people of all ages, from youngsters of eight or nine to oldsters in their seventies, surmount

that awesome barrier every summer to enjoy the nature lover's paradise beyond. And one glance at these travelers at the end of their pilgrimage would convince you that it is the road-fiends below who have worn themselves out on vacation.

We learned that there are several ways in which a vacation like this might be taken. We could rent a mule or a burro to carry our dunnage and food and camp by ourselves wherever we pleased. Another way would be to hire a packer-guide to take us to a camping spot and later return to escort us out. A mule would cost us around five dollars a day, a burro a little less.

# Timber-line Trails

By CATHERINE and DICK FREEMAN

*All photographs by the authors*

▼ **UNNAMED LAKES:** a view southward from the summit of Forester Pass, looking toward Kings Kern Divide. The lakes are nearly 2000 feet below the photographer







▲ PACK TRAINS through the Sierra Nevada usually travel in "strings" of five or six animals, with a wrangler in charge of each. When the route is cut in a steep slope, the law of the trail requires everyone to get fifteen to twenty feet to one side and remain motionless

► THE AUTHORS about to take off on a day's hike, with knapsacks containing about 45 pounds of camera equipment in addition to lunch

▼ WET BUSINESS for the pack animals. The wrangler fixes the loads as high as he can and then leads the mules from his horse





That expense alone would amount to about one hundred and fifty dollars for our four weeks' vacation. And if we had a packer take us in to a central camp, we would not have opportunity to cover as much territory as we wanted to. In either case, we would have to make our own arrangements for food.

A third possibility was to go with a hiking organization known as the Sierra Club of California. A number of these hiking organizations have become popular over the United States. The well-known Appalachian Club of the Eastern States, the Iowa Mountaineers, and the Mazamas of Washington State are but a few of them. Several of these groups organize camping trips of two or four weeks each year

into high mountain areas that enable cramped city dwellers to get away from the complexity of our machine-regulated life and enjoy the peace and beauty of nature.

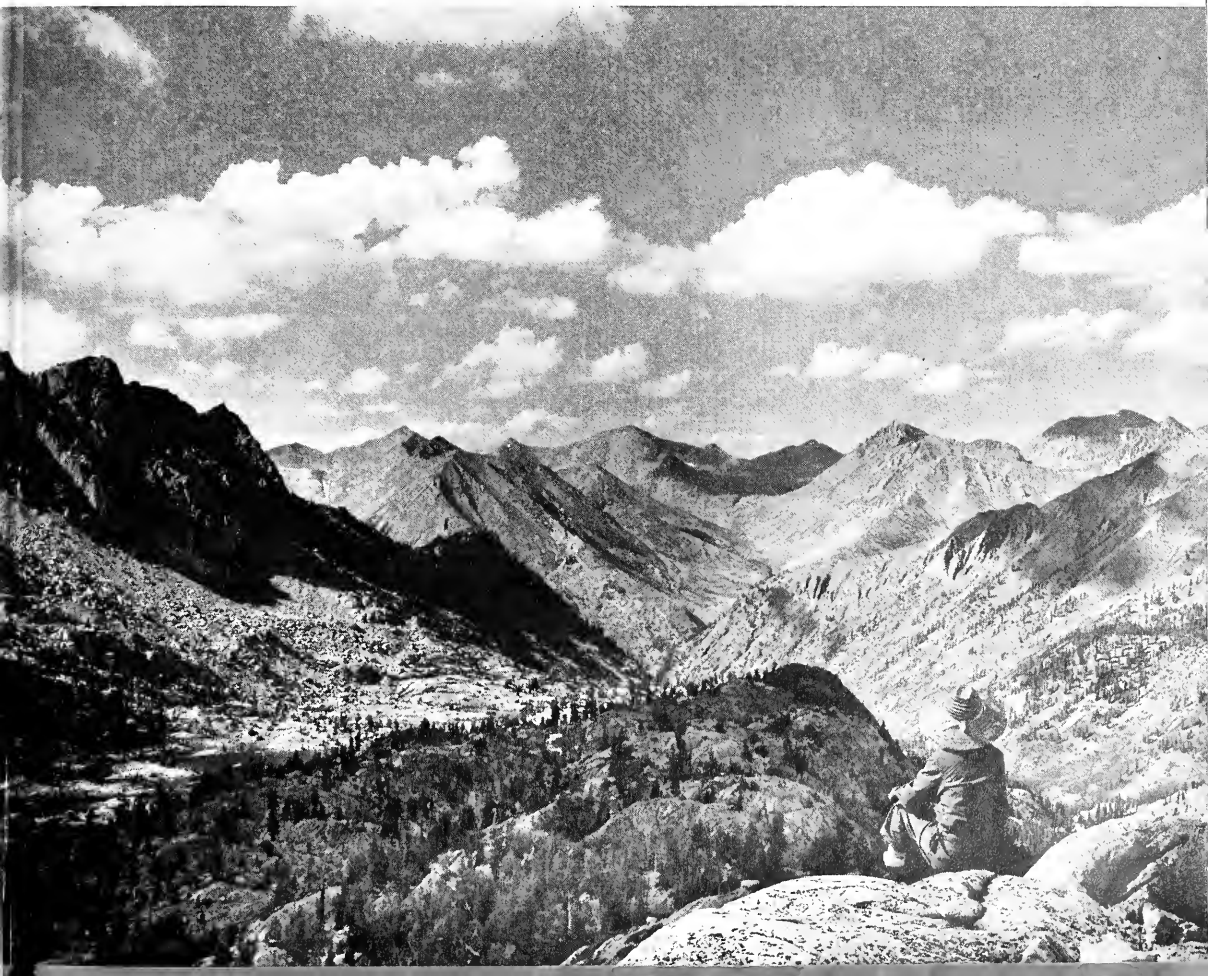
The Sierra Club would transport our luggage and provide food for fifty-five dollars apiece for two weeks. We would not have the burden of choosing camps or preparing food, and we would have wide latitude to follow our own activities. We could explore and photograph 100 to 150 miles of the highest section of the lofty Sierra. Our minds were made up. We looked forward with zest to making

the acquaintance of the rock rabbit and the rare *Polemonium*, which only blossoms above 11,000 feet.

These trips begin at a selected pack station to which the prospective hikers drive by automobile. They then "hit the trail" and average about ten miles every other day. The trip ends at another pre-arranged place to which it has been possible to shuttle the automobiles.

Early in July we started out upon our great adventure, tramping over the crest of the Sierra south of Mt. Whitney. All trails that climb this barrier zigzag back and forth until they surmount some high pass, from

▼ INSPIRATION and the opportunity to contemplate the universe. From each lofty pass and peak, the hiker surveys tree-filled valleys and canyons. A view looking north over the Upper Basin in Kings Canyon National Park



which the hiker can gaze spell-bound upon the lovely lakes and mighty forests of the unspoiled wilderness beyond. It is a rare, unforgettable experience—that first night beneath a measureless vault that is studded with more stars than you have ever seen before in your life. The aroma of evergreens drifts up from the meadows below, and you suddenly realize that the silence is keeping you awake. It comes over you that a little adjustment is going to be necessary to make you a normal human being again, and presently you are sound asleep, having the best night's rest you have enjoyed in some time.

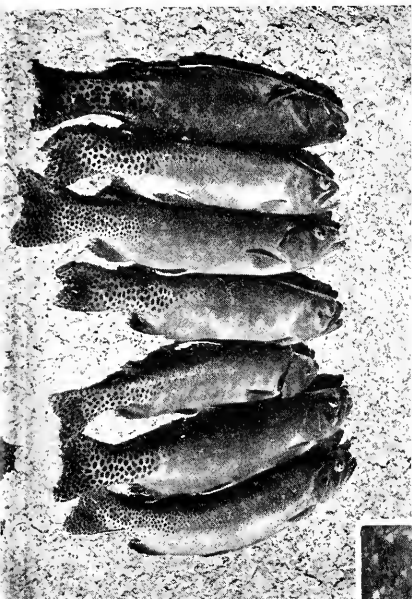
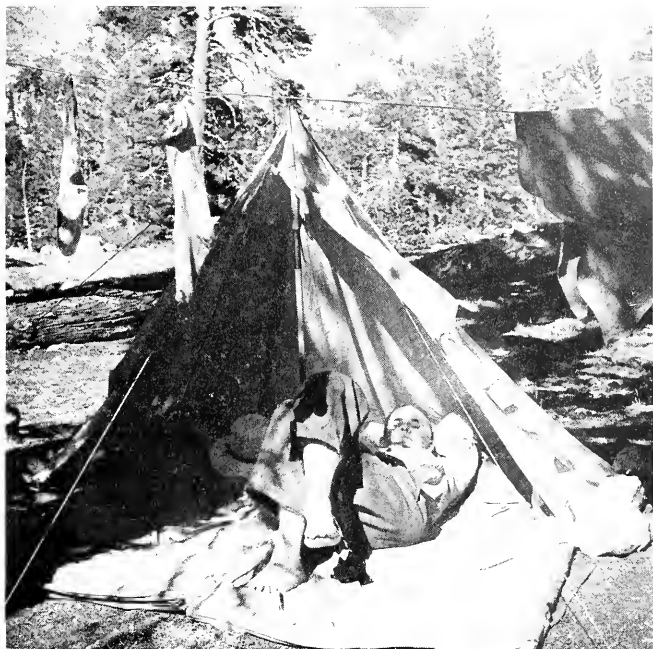
"In your knapsack," the club instructions warn you, "you must carry a flashlight, matches, and a light extra jacket or sweater. A lightweight raincoat is also advisable." This is good advice. It *can* rain. We slept in sleeping bags, which came within the 30 pounds of dunnage allowed. But there wasn't much room for tents or rainproof sheets. We carried a sort of half-tent that weighed about five pounds and went over the heads of both sleeping bags placed side by side on a waterproof ground sheet. We covered the lower parts of our bags with our raincoats. Fortunately, it rained only two nights and not

enough to inundate us. We can laugh now, but it wasn't funny undressing inside our bags, with the tiny tent tied together in front to keep the rain from pouring in. Once safely down inside the warm sleeping bag, of course, the patter sounded delightful, and it was an enthralling sight to see the clouds billowing up out of the canyons as the storm cleared, exposing the tiny lakes like strings of sparkling jewels.

Along with our sleeping bags, we each carried what we called our pine tree chiffonier. This was a piece of strong cloth about two and one-half feet square, onto which a num-

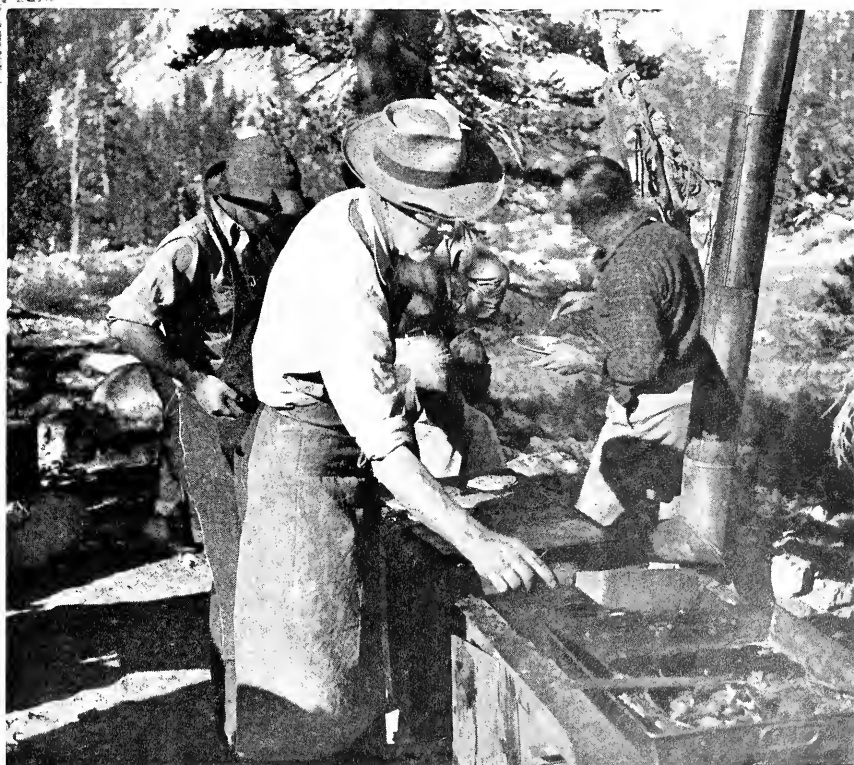


➤ NOTHING LIKE a little snooze in the late afternoon to relieve that tired feeling. This shows how a small tent can protect the heads of the sleepers



▲ A CATCH of golden trout from Arctic Lake

➤ THE CENTRAL COMMISSARY is one of the advantages of a large party. Here the cooks are frying flapjacks for an early morning getaway



◀ A FISHERMAN tries his luck in one of the small unnamed lakes near the western slopes of Mt. Whitney. To the west is seen the Kaweah Range



◀ HIGH above the tree line are born tumultuous streams that go cascading down to the valleys below. Upper Basin on the South Fork of the Kings River

➤ ONE of the most beautiful sections is around Rae Lake, seen here far below, with F. Dome on the right and M. Rixford and Dragon Peak on the left

▼ LOOKING SOUTHWEST across Bullfrog Lake toward Mt. Brewer, 13,577 feet high. The countless mountain lakes and streams in this area make it a fisherman's paradise







ber of pockets were sewn. In these pockets we kept our clothes, toilet articles, and anything else we wanted to stow safely away. With each pocket tied shut securely with a tape, the whole bag could be conveniently rolled up within the sleeping bag itself, or it could be hung on a pine tree where everything was easily accessible.

In addition to the prescribed "necessities," we would have been unhappy the entire time without our camera equipment. We took a 4x5 view camera for general pictorials, a 3½x4½ Speed Graphic for action shots, and a 35 millimeter camera for color, plus films and all the necessary attachments, which made a heavy pack for both of us. Hiking along a trail is at times rather dusty, and delicate equip-

ment that is not properly covered will suffer. Therefore, each camera had its separate bag, as did the films and other pieces of equipment. Picture taking, consequently, became quite an operation.

"Get the tripod ready while I get the 4x5 out," one of us would call. Out would come the tripod while the other would get the film and filters, adjust the focus, and take a meter reading.

"What does it look like?" Each of us had to examine the image on the ground glass, of course. And after the black-and-white picture was taken, we usually wanted a color photograph. There followed a complete shifting of equipment. Sometimes 20 minutes to half an hour passed before we were ready to move on. But we gained speed

with experience—and we brought something of the mountains back with us.

The photographs shown here, selected from the scores we took, may give some idea of the land beyond the ramparts of the Sierra—"on the other side of the moon" as far as most people are concerned, yet really not very far from the scorching highways of Owens Valley. They will not bring to your ear the enchanting song of the hermit thrush in the woods, the delicate beauty of the mountain cyclamen, or the flavor of a sparkling stream to a parched throat, but these things you can experience yourself, if you're willing to give your tired old automobile a rest for a couple of weeks—not to mention your own nervous system.



Acme photo

### Brains and the Beast IV

By FRANK A. BEACH  
Professor of Psychology, Yale University

**T**WENTY-THREE hundred years ago, Aristotle wrote that many animals can learn and remember but that only man can reason. This conclusion has been challenged many times during the ensuing centuries, and even today men still ask, "Can animals reason?" The query is nonsensical and therefore unanswerable. What "animals" are meant? Peacocks? Protozoa? Amoebae? Ants? Monkeys? Men? (After all, men *are* animals.) And what is meant by "reason"? Before engaging in wordy debates about reasoning in other creatures, we would do well to think seriously about reasoning as it occurs in human beings.

#### "The Rational Animal?"

From the time of Heraclitus (500 B.C.), man has gratuitously described himself as *the* rational animal. What does the title imply? Philosopher John Dewey regarded reasoning as a special method of problem solving. (This is helpful. We should, then, begin our search for reasoning in other animals by observing them when they are trying to solve problems.) Dewey added that reasoning usually occurs in four steps.

## Men Can Animals Reason?

To what extent does reason govern our lives, and how does habit become its foe? Problem-solving experiments with man and animals force us to revise our thinking on these basic issues

(1) First comes the analysis of the problem. (2) Next, the reasoner formulates one or more hypotheses that represent possible solutions. (3) Then these hypotheses are tested, one after another. Man usually tests his hypotheses by talking to himself about them. He may not speak aloud, but his thought takes the form of unuttered language. In the course of his subvocal soliloquy, man exposes the weakness in each erroneous hypothesis and then discards it. (4) The final step comes when he hits upon one that stands the test. He puts it into action, and his problem is solved.

If this emphasis upon the importance of words in reasoning is justified, it is difficult to see how lower animals, lacking a language, could employ reasoning. But we need not surrender without a fight. Let's look at the facts. Is there anything in the behavior of other animals that resembles, however slightly, Profes-

sor Dewey's description of human reasoning?

Yes, there is. He mentions the formulation of hypotheses as a first step, and one psychologist has written a whole series of erudite scientific articles on the general subject of "Hypotheses in Rats." His experiments show that when a rat finds itself confronted with a novel problem, it does not attack the situation blindly. Instead, the rodent "progresses through a series of systematic behavior patterns, adopting one form of response, persisting in it for some time, dropping that habit [if it is unsuccessful] and adopting another, and so on."

In other words, the languageless rat cannot test his "hypotheses" by

discussing them with himself, but he can put them into practice to see if they will work. The significant point established by these studies is that when the lowly rat is trying to solve a problem, he displays adaptability. If one approach proves fruitless, he has enough sense to drop it and try another. This ability by itself certainly is not reasoning, but there could be no reasoning without it. Perhaps it is not too much to say that variability of approach is one evolutionary forerunner of human reasoning.

#### Perseverance or Pigheadedness?

As a matter of fact, the ability to give up an unsuccessful line of attack and shift to a new one is fundamental to practical reasoning. The failure to do this frequently keeps people from developing their reasoning powers to the fullest extent. Some men who pride themselves on their stick-to-itiveness are in



reality confusing perseverance with pigheadedness.

Another psychologist has scientifically analyzed human reasoning in the experimental laboratory. He devised a series of rather simple mechanical problems for college students and then watched while various solutions were tried. After everyone had either solved the problems or given up in disgust, the group was given some practical suggestions on how to reason.

The advice was surprisingly simple. (1) When you are confronted with a problem, try to locate at least one of the difficulties, and then try to overcome it. If you fail, get that difficulty completely out of mind for the time being and look for an entirely different one. (2) Do not be a creature of habit and stay in a rut. Keep your mind open for new meanings. (3) The solution pattern appears suddenly. You cannot force it. Keep your mind open for new combinations, and do not waste time on unsuccessful attempts.

At the conclusion of the lecture, a second series of problems was presented. This time the average score for the group was twice as high as it had been before. These results agreed with John Dewey's belief that reasoning does not depend entirely upon native ability. The efficiency with which we reason can often be improved through deliberate training.

The psychologist's advice about staying out of a rut and keeping an eye open for new solutions recalls the white rats and their "hypotheses." Their behavior involves a great deal more than one is apt to realize. The ability to give up one line of attack and shift to a new one is quite limited in animals that belong below the mammals in the evolutionary scale.

If a hungry octopus is separated from his prey by a sheet of clear glass, he behaves in a curious fashion. The tentacles writhe over the surface of the barrier, and the animal's body strains against the smooth surface. There on the opposite side, just out of reach, is a delectable prawn. The octopus expends every effort to force his way to the food *by the most direct route*.

It would seem a simple matter for him to move sideways just far enough to pass around the edge of the glass. But this would mean moving away from the visible prey, and such a course of action is too much for the cephalopod "mind."

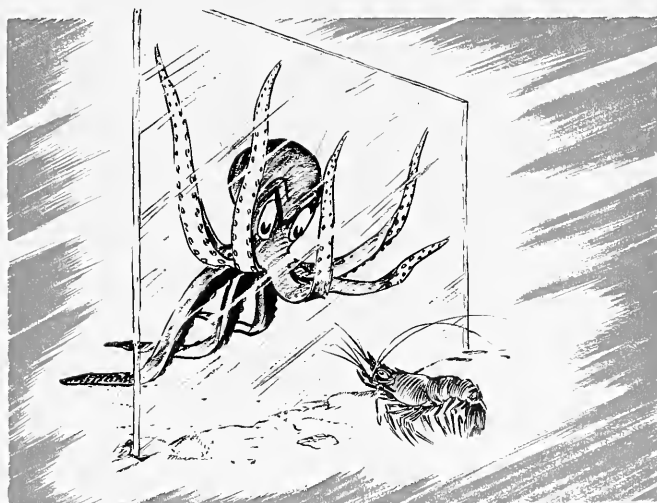
When hunting under normal conditions, the octopus will follow a prawn that has disappeared behind a rock. Yet when his dinner is in plain sight but mysteriously unobtainable, only one "solution" occurs to the octopus, and he cannot discard it even though it always results in failure. Ophelia, the "Clever Octopus" recently shown in *Life*, first *accidentally* knocked the lid off the food jar. It learned by trial and error. Here we are talking about reasoning.

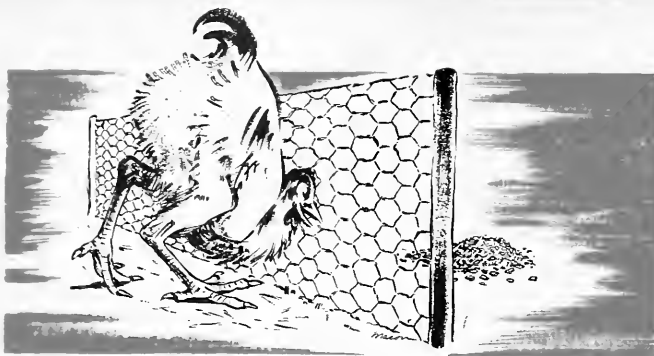
Some birds aren't a great deal different from the octopus. A hen separated from a pile of corn by a short length of chicken wire fence is a pathetic sight. She stands in the center of the fence directly opposite the grain and clucks nervously. The unobstructed pathway around the end of the fence is plainly visible, but to turn away from the food is very difficult. The bird runs a few steps toward the end of the fence, hesitates, and then dashes back to the spot just opposite the corn. Another half-hearted excursion toward the end, and another loss of courage and return. Feathered indecision! Gradu-

ally the trips away from the food grow longer, and finally the hen rounds the turn and comes flying down the homestretch to gobble up the corn. Here is an example of extremely limited variability of behavior. One would not expect reasoning in such a creature.

Mammals are much more adaptable. Anyone who knows dogs will tell you that they can master this type of problem with little or no difficulty. In one experiment, a Canary Island bitch was put on the inside of a U-shaped wire fence. Then a nice, meaty bone was dropped just outside the fence at the base of the U. For a few minutes the dog tried to push her paw through the wire. Then she dug at the dirt in an unsuccessful effort to tunnel under the fence. Briefly she gnawed at the wire; but within a few minutes she gave up these fruitless forms of attack, sat down, and looked about her. In a flash she was on her feet, running, and in less time than it takes to tell, she had the bone in her teeth.

For human children such a situation hardly deserves to be called a problem. A little four-year-old girl was led into the same U-shaped enclosure, and her favorite doll was laid on the grass just outside the fence. The child looked at the wire, followed it with her eyes, and immediately saw the opening behind her. A happy smile lit her face; she





began to laugh and ran swiftly around the fence to where the doll lay.

Such experiments are too simple to reveal the existence of reasoning, but they do tell us where to look for it. Any animal species that shows limited variability in simple types of problem solving is quite unlikely to demonstrate reasoning ability in any situation.

#### **Man + Habit = Octopus**

The inability to respond adaptively when faced with a problem may be due to lack of the necessary brain development. This would seem to be the explanation in the case of the octopus and, to a slightly lesser degree, in the case of birds. Unfortunately, however, possession of a well-developed cerebrum is no guarantee that reason will rule behavior. In man himself there are many foes to reason, and one of the most powerful is habit. In some life situations, man's habits make him behave like an octopus when it comes to meeting new problems.

Many times we encounter a new problem that bears a superficial resemblance to some we have solved before. Then we are likely to persist in attacking the novel difficulty with unsuitable methods just because they have been successful on other occasions. More than once an amateur has solved some problem that had been puzzling experts for years. Sometimes the amateur is smarter than the experts, but more often his only advantage is a fresh point of view. His approach to the solution is not cluttered up with habitual modes of thought about the problem.

From early childhood we build

up habits that guide our day-to-day lives. It is fortunate that we can do so. Imagine how troublesome life would be if we had to solve every problem anew each time it arose. In 99 out of every 100 of the little problems confronting us each day, habit provides a ready-made answer, and original thinking is unnecessary. It is only when old habits will not serve that reasoning makes its appearance.

Habit limits our ways of thinking about a problem, and this is a very real block to successful reasoning. The trouble may originate at a very simple level. The way in which we "see" a problematical situation has a powerful control over our ability to solve it.

In one experiment young men and women were led into a bare room and given three candles, three thumbtacks, and three small boxes. They were instructed to fasten the candles to the door of the room in any way they could devise. There was only one solution, but it was simple. The boxes were fastened to the door with thumbtacks, and one candle was placed upright in each box. Every individual discovered this method in short order.

Then the experiment was repeated, using a new group of "subjects" and introducing one minor change in the setup. This time the little boxes contained matches. The rest of the equipment was the same, and so were the experimenter's instructions. Less than half of the

➤ **IN HIS EFFORTS** to reach the food outside his cage, Sultan forced two sticks together and made a new tool long enough to fit his needs

men and women solved the problem.

What was the difference? In the second version of the experiment, most of the people "saw" the boxes as containers for matches, and this blocked the possibility of "seeing" them as potential candleholders. Furthermore, the presence of matches was distracting, for they suggested (due to habit) lighting the candles. A burning candle suggested (due to habit) the use of hot wax as an adhesive. The problem had been designed so that no such solution would work. Nevertheless, the force of habit was so strong that many individuals stubbornly persisted in trying minor variations on the same futile theme. The little boxes continued to be match containers, and the thumbtacks were simply ignored.

#### **Reasoning Is More than Learning**

By simple trial and error man and many other animals are capable of learning how to meet certain types of problems. This is something different from reasoning, which always consists of devising the solution to a problem which has not previously been mastered through learning. Therefore, it is almost impossible to decide whether or not a particular item of behavior viewed in isolation is or is not the product of reasoning.

The difficulty is beautifully illustrated in the story of Congo, the fastidious gorilla. Congo had the distinction of being the first of her species to serve as the subject of psychological experiment. In one test she learned to reach through the bars of her cage and operate various mechanical devices. One

*Photo courtesy Wolfgang Köhler*



sunny morning after a rainy night, the scientist approached her cage and called Congo to work. The ape emerged from her living quarters and lumbered over to the bars, apparently anxious to begin the day's tests.

The floor on which she usually sat was still wet. Congo looked at the puddles for a moment, scratched her head, and then deliberately turned her back on the experimenter and returned to her bedroom. Shortly she emerged, her arms loaded with dry straw from her sleeping couch. Carefully depositing the straw on the damp cement, the fastidious gorilla sat down on her improvised cushion and gestured to indicate that she was now comfortable and ready to work.

Now does this performance reflect reasoning? It is impossible to decide. There is always the possibility that puddles on the floor was an old problem for Congo and that in going after the straw she was acting by habit. You may say that she must have solved the problem some time, or the habit wouldn't be there. That is true, but we don't know *how* that first solution was achieved. It might have been the chance product of a very long process of trial-and-error behavior and, as such, not due to reasoning.

This attitude may seem over-cautious, but it really underlies our everyday judgments of human beings. I once won the reputation of possessing great reasoning powers because I solved a conundrum that baffled every other guest at a party. When I finally confessed that I had heard it before, my stock as a reasoner dropped a long way. The original, flattering reaction had been based upon the assumption that the problem was a new one and that therefore my solution was original. Another puzzle was presented, and more than half of the guests finally found the answer, but this time everyone made many mistakes, advanced many incorrect answers, and finally reached the solution by a laborious process of elimination. No one was crowned King of Reason. Why? Because unconsciously we do not accept trial-

➤ **EAGER** for the food hanging in mid-air, the chimpanzee builds his own "stepladder" from wooden crates scattered about the enclosure

and-error behavior as true reasoning.

If asked, "Can animals reason?" one is apt to say "Yes" without a second thought. By refusing to take the answer for granted, we have tried to straighten out a few of the difficulties that might have prevented us from a correct evaluation. We have seen several ways in which reasoning can be defined and ways in which human reasoning can be observed in action. Yes, there is some evidence to suggest that lower animals can reason, but lest we expect too much from the experimental results, let us hold firmly in mind the fact that men and women employ reason only at infrequent intervals, and even then reasoning does not come easily to The Reasoning Animal.

#### When the Heart Rules the Head

It is sad but true that grown men and women often become quite emotional when they find themselves in life situations demanding analysis and the formulation and testing of hypotheses. When anger or fear or anxiety (and some old sourpuss is sure to add, love) comes in the door, reason flies out the window.

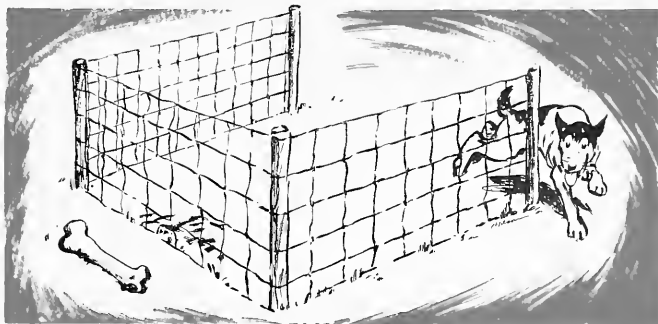
The same shows up very clearly in other animals. Many psychologists have observed that the chimpanzee resembles man in emotional make-up more closely than in general intelligence; and these anthropoid apes sometimes behave in distressingly human fashion when



Photo courtesy Wolfgang Köhler

called upon to solve problems.

Koko, a three-year-old male, was one of a number of animals used in a series of experiments on problem solving. He was obviously gifted, but like some human geniuses, Koko was a slave to temperament. If his first few attempts to solve a new problem failed, the little ape was apt to fly into a rage, hopping first on one foot and then on the other, pommeling the floor with his fists, and screaming at the top of his lungs to express his frustration. Since the reasoning tests occurred with regularity, Koko was usually in a state of chronic indignation. Of course, his performance suffered, because these emotional outbursts totally prevented any ob-



jective analysis of the problematical situation.

Every chimpanzee had a distinct personality. Nueva, a young female, had a trusting disposition and winning ways that almost made one forget that she was partly bald and, by human standards, decidedly ugly. She showed a childlike attachment to the experimenting psychologist. Then, too, there were Sultan and Konsul, both males and as different as night and day, but each in his own way was an efficient problem solver.

### Tests in Tower Building

All of the problem-solving tests were quite simple. They were based upon two principles. First, the animal must be offered some truly attractive reward, but the simple, direct approach to the prize must be blocked. Second, the ape must be in a position to survey the entire situation, to study the various possible solutions without actually having to go through the motions of trying them out.

In one test a banana was suspended from a high limb, and the little chimpanzees were prevented from climbing the tree. In order to earn their reward, they had to work out an original solution. Discarded packing boxes of various sizes were left scattered about the enclosure in which the animals worked. Would any ape hit upon the idea of moving a box under the dangling fruit and using it as a stepladder?

Some chimpanzees did exactly this without any human guidance. Several of the animals became so adept that they could reach bananas that hung several yards above the ground. The simian engineers sometimes employed as many as four boxes stacked one upon another. The completed structures wouldn't have conformed to any sort of safety regulations. They were so rickety that they swayed perilously to and fro as their intrepid builder clambered toward the top. But the apes had implicit confidence in the products of their own labors, and if the movement became too violent, the climber merely took off with a flying leap, snatched the banana at the peak of his jump, and then

fell to the earth. Landing on your feet is easy if your ancestors have spent most of their lives in trees.

Does this sort of behavior show reasoning ability? Well, the problem was novel. These apes, reared in captivity, had never before found their meals hanging in mid-air. Much less had they been taught to build their own stepladders! On some occasions, at least, the solution was hit upon suddenly, with little or no fumbling, no trial-and-error behavior. But before passing judgment, let's examine more of the evidence.

There is a story, possibly apocryphal, about a psychologist who shut a chimpanzee in a soundproof room filled with dozens of mechanical toys. Eager to see which playthings the ape would choose when he was all alone in this treasure house, the scientist bent down on his knees and put his eye to the keyhole. What he saw was one bright eye peering through from the other side of the aperture. If this anecdote isn't true, it certainly ought to be, for it illustrates the impossibility of anticipating exactly what an animal will do in a test situation.

After Koko, Konsul, and the others had been stacking boxes for a few days, they began to generalize from their experience in surprising fashion. One day, when a bit of fruit was hanging on high and no boxes were available, the psychologist strolled into the enclosure. One enterprising young ape rushed over to the experimenter, seized him by the seat of his pants, and dragged him to a spot directly beneath the banana. Then the chimpanzee pushed and pulled in an effort to get the scientist to bend over so that his back would provide a platform to be used in lieu of a box.

Such surprises occurred more than once. The animals sometimes solved their problems in ways that had not occurred to the experimenter when he designed the test. On one occasion the bait was suspended in a basket from a high limb, and the apes were given long bamboo poles. The psychologist expected the poles to be used to tip

the basket and spill its contents, but he had forgotten that chimpanzees are natural-born acrobats. Placing a pole upright but unsupported directly beneath the basket, they swarmed rapidly up the stick and snatched the reward before the pole could fall over.

### "Please Pass Me the Rake"

Sociologists sometimes describe man as a "tool-using animal," as though this were a unique characteristic. As a matter of fact, many animals from wasps to walruses are said to use rocks or twigs as a man uses a sledge or lever, and some apes have shown the ability to manufacture tools to suit their needs.

Favorite types of food were thrown on the ground several feet outside an ape's cage, and a short length of bamboo was left lying within reach. Some chimpanzees grasped the solution with little delay. Picking up one end of the bamboo, they extended an arm to full reach through the cage bars and raked in their reward.

Sultan went a step further. He was given two pieces of bamboo, neither of which was long enough to reach the food. After trying various possible solutions to his personal problem, Sultan began to gnaw on the end of one of the sticks. When he had reduced its size sufficiently, the ape forced the tapered end of the smaller stick into the hollow end of the larger one, thus constructing a new tool long enough to meet his needs.

These experiments with chimpanzees represent a very small part of the work that comparative psychologists have conducted in their attempts to plumb the animal mind. Other tests have been used, and many species from birds to baboons have been studied. Some of the methods have resembled those described here, and others have been quite different; but in nearly every case the underlying assumptions concerning the nature and manifestations of reasoning have been very much the same. Reason has been regarded throughout as a special way of solving new problems.

As a matter of fact, it is more

*Continued on page 137*



# “Long-Ears” *Family*

Bullet-riddled signs now mark the spot where these fascinating observations were made on a family of Long-eared Owls—victims of trigger-happy “sportsmen”

By LEWIS W. WALKER

*All photographs by the author*

A FEW miles from San Diego there is a fairly deep ravine known as Tecolote Canyon. The name means “Owl” and has been passed down from the days of the early Spanish settlers. Most places that have been named after animals no longer deserve to be, because people have killed off the wild

creatures. But Tecolote proved to be an exception. It actually contained a pair of owls that lived in an abandoned Cooper’s Hawk nest 25 feet from the ground.

The first time I climbed the scrub oak, I almost reached the edge of the nest before there was any sign of life. Then from above there came

▲ SOMETIMES the young owls would sway back and forth, trying to duplicate the beak-snapping of their parents

a slow moan, which changed in intensity and became a caterwauling that reminded one of a battle of angry cats. If I held my position, the hideous noise would subside, but at my slightest movement it was repeated.

Finally, the face of a female Long-eared Owl peered stealthily over the edge of the nest. Then, as I climbed higher, she put on one of the most beautiful shows I have even seen in the wild. She noiselessly extended her wings, with the feathers raised to a vertical position, along their entire length, forming a half circle of mottled mahogany. Though she probably weighed only about a pound, she stood her ground within arm’s reach of me. She bluffed with every ounce of her small body and assumed a position and size that I must admit was somewhat terrifying.



▲ THE MOTHER OWL, which only weighed about a pound, spread her wings and stood her ground within arm's reach, presenting an awesome appearance

On my next visit the owls tried a different technique; they became secretive and endeavored to blend into the background. One, on a broken bough about 40 feet from the nest, watched my movements unobtrusively through eyelids that were closed to mere slits. Every feather was clamped to the body in a pose that gave the bird a stick-like appearance. The "ears" or "horns" were raised to vertical points, so the over-all picture was of a rustic stump with two jagged splinters protruding from the top.

Dusk brought another ruse, perhaps the highlight in this show. Now the actors seemed willing to try anything once. I was setting up a photographic blind eight feet from the nest on the branch of an adjoining oak. An anguished squeaking

like that of a small mammal in distress drew my attention to a commotion in the grass. As I hurried to investigate, one of the owls flew up only to alight again 50 feet farther on, where another battle with an imaginary adversary was staged for my benefit. On and on the bird led me.

It was practically dark when I returned to the nest, but the persistent owls continued their repertoire under the beam of a spotlight. Lying on one side, an owl would push itself along the ground with one wing alternately flapping and dragging. If I followed, the bird would lead me away; but whenever I retraced my steps toward the nest, she underwent a miraculous recovery of the feigned injury. She would fly back to intercept me, land in the path, and then repeat the same antics. As long as the flashlight was pointed on her, she would continue her convulsions; if it were held a little to one side, she was quick to turn and seek the spotlight.

As I climbed to my partially completed blind, both of the adults became antagonistic and dove repeatedly, missing me by mere inches. Their maneuverability was remarkable. The tops of the scrub oaks formed an almost solid blanket of branches, twigs, and leaves; but the owls would dive through this maze at a breakneck speed and successfully go through openings that seemed far too small for their hurtling forms.

During most of my work on the blind the young lay in a motionless heap, but now with darkness they, too, became brave and defiant. They sat on their haunches and swayed back and forth, feebly trying to duplicate the constant beak-snapping of the adults. This involved a series of methodical slow-motion steps. A beak would open, a tongue would protrude from one side, and the beak would clamp shut as the tongue was withdrawn. The result was a faint snap, hardly worth the effort.





▲ A FOURSOME of prospective rodent-catchers

► FAMILY GROUP: parent owls showing distress over possible danger to their brood

My first flashlight exposure produced results that I feared would bring a sudden end to my observations. An adult had been standing over the young and glaring at the blind and its array of reflectors and cameras. A pressure on the switch fired three bulbs simultaneously, and for a fraction of a second the old bird froze with her wings outspread; then she went off in full flight. For a hundred feet or more I could hear her breaking twigs in her flight from this noiseless lighting.

For a half-hour the only noticeable noise was the constant hum of mosquitoes, which ran a busy shuttle between owlets and photographer. I visualized the bird as a disheveled mass of broken feathers, but I later learned that feathers soft enough for almost noiseless flight will rarely break. Finally a plaintive "meowing" came from far down the canyon, and it was answered by a subdued series of "whoo's" from behind the blind.

*Continued on page 140*

"LONG-EARS" FAMILY



# Drawings

BY A  
FIELD ARTIST

*Wildlife Sketches by William R. Leigh*

W. R. Leigh



A HANDSOME MALE LION, with a fine mane



WART HOG. This African representative of the pig family fights bravely. It enters its burrow backwards



BLACK RHINOCEROS. Leaves and twigs are its main food. It grasps them with its pointed, prehensile upper lip



A ONE-MAN exhibit to be held in the Grand Central Art Galleries in New York City from April 13 to 24 will signalize the talents of a distinguished American artist, whose work forms an integral part of Akeley African Hall at the American Museum. William R. Leigh accompanied the Museum's African expeditions of 1926, 1927, and 1928, which secured specimens and accessories for this famous hall, dedicated to Carl Akeley, the father of modern habitat group technique. During his association with the project, Mr. Leigh was master background artist, and he personally

Painted a number of the scenes.

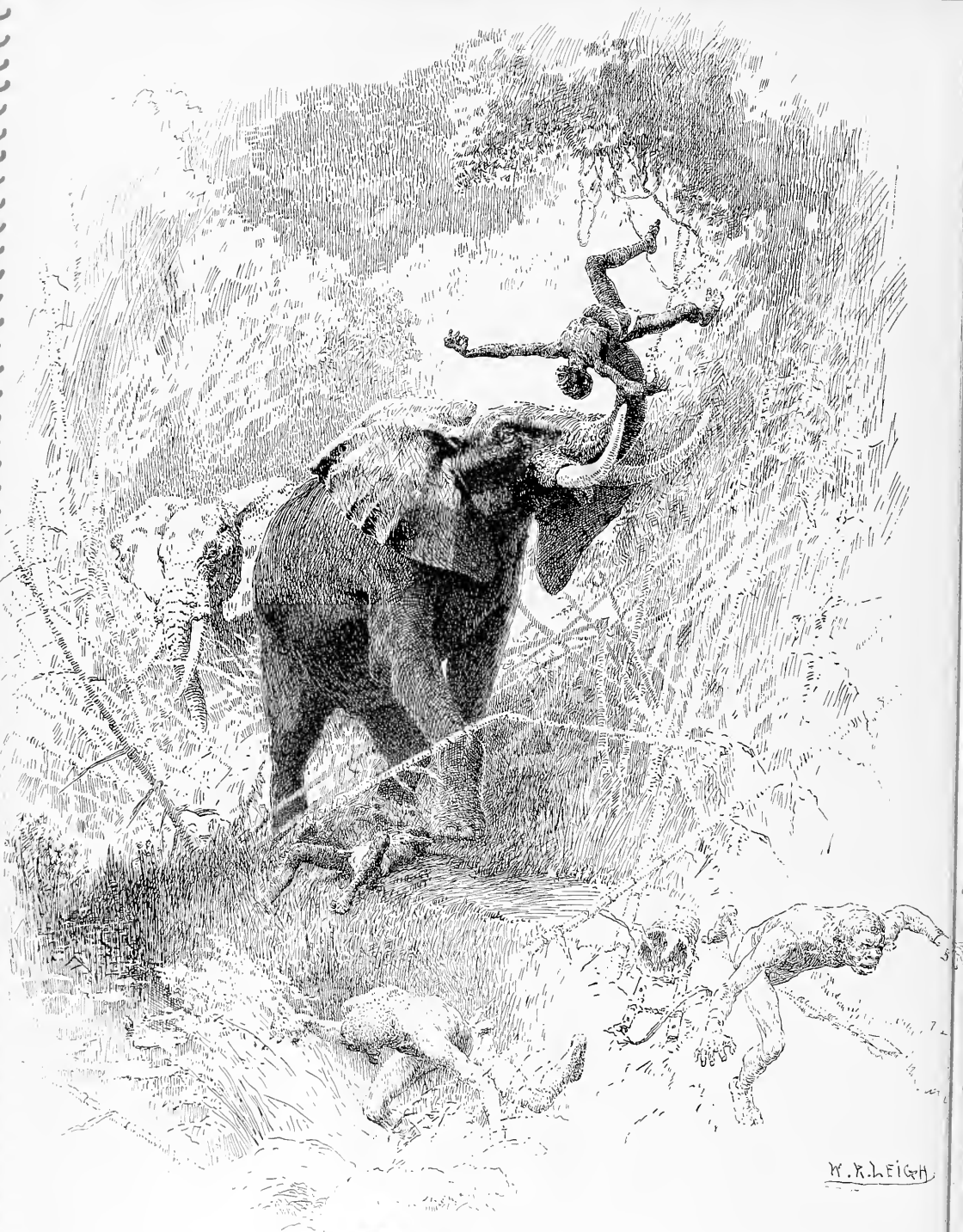
The pen-and-ink drawings shown here are selected from a vast number of animal sketches which Mr. Leigh did to illustrate a book relating his African adventures, *Frontiers of Enchantment*. His lifelike and precise sketches have been an inspiration to many students of art and will doubtless encourage others less practiced to try their hand at portraying the world of nature. It surprises many visitors to the American Museum to learn that the backgrounds of the exhibits have been painted by artists of such merit. Though the Museum is de-

voted primarily to science rather than art, these exhibits contain the work of many of the most celebrated modern artists of wildlife and the wilderness.

William R. Leigh was born and bred in West Virginia and is a descendant of Pocahontas. He had a thorough training in outdoor life and in hunting local birds and animals, but he has learned to like a live animal much better than a dead one. He has devoted much of his career to portraying the American West, and his frontier studies will form a prominent part of the coming exhibit.



A DRAMATIC PORTRAYAL of natives in Tanganyika spearing a lion. Cattle thefts by lions lead to such a hunt. Thirty to fifty men, armed with spears and shields of buffalo hide, stalk the beast. A daring thrust is followed by a rain of spears. Sometimes one of the men is killed but not often



W. R. LEIGH

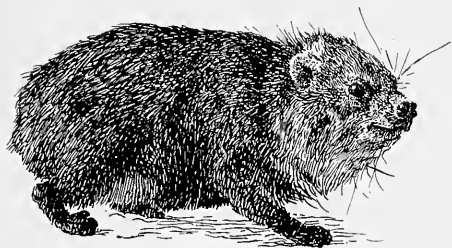
**ELEPHANT ATTACKING NATIVES IN UGANDA.** An enraged elephant will fell a man with his trunk, gore him with his tusks, trample on him, then fling the body 75 feet or more away



**WILD DOG.** It hunts in packs and is very destructive to game, particularly the smaller antelopes. It travels fast and sometimes hunts by moonlight



**GRIFFON VULTURE,** a common scavenger of the African Plains

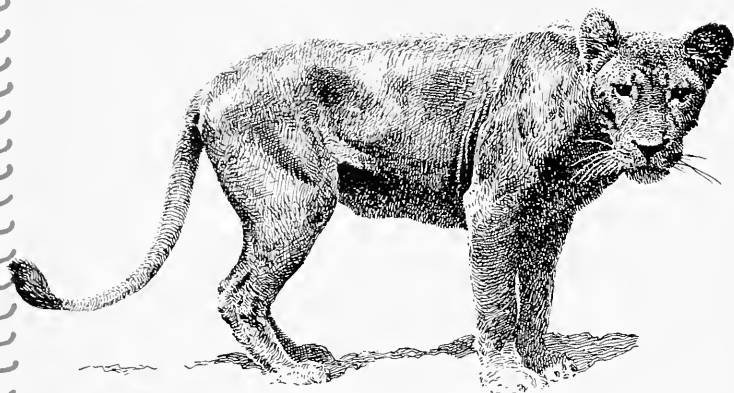


**HYRAX.** This little animal resembles a rodent externally but is a true hoofed animal



**KAVIRONDO CRANE:** one of the most beautiful birds in the world. It has a pearl-gray, black, and brown body, a velvet-black head with white and red cheeks, and an amber crest



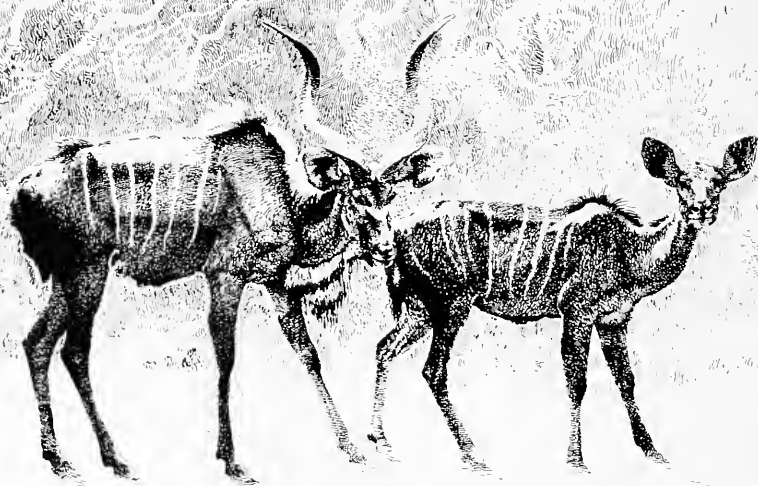


LIONESS: in repose a beautiful, appealing animal but a most adroit assassin

W. R. Leigh



GREATER KODOO. It carries the longest horns of any of the African antelopes



THOUGH fairly common in some areas, the Greater Koodoo has been exterminated in others. Old bulls with fine heads are especially elusive

W. R. Leigh





W. R. Leigh

A NATIVE interfering with a lion and lioness that are invading his thorn corral to attack the terrified cattle. It is possible to drive off one lion, but when two or more attack simultaneously, the situation is more serious

# Meet the CURATOR

A candid view of the man who answers your scientific questions and who travels to all corners of the world to get information and specimens for public exhibition

By C. L. HAY

*Research Associate, Department of Anthropology,  
American Museum of Natural History*

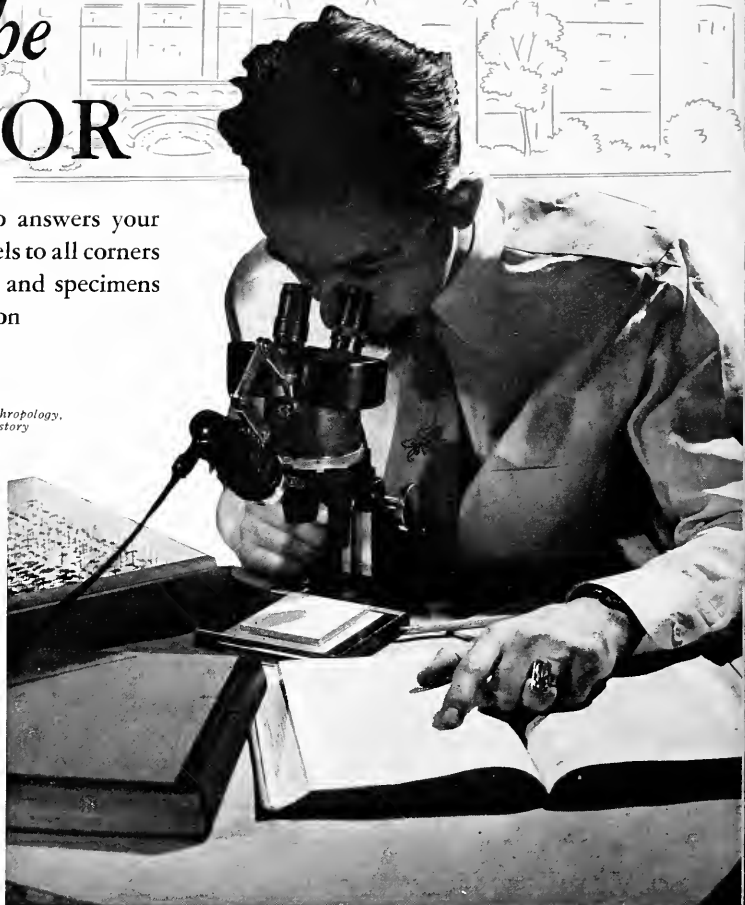
THE word "curator" comes from the Latin word meaning "to care for," and the museum curator was originally the one who cared for interesting objects placed on display. More recently, the curator's duties have extended much further. He often makes long expeditions to gather the material and devotes much time to studying it scientifically and writing about it. And because the public is always curious to know more about these things, it has devolved upon the curator to take care of their inquiries—a no small part of his day's work.

Perhaps you would like to become better acquainted with this person to whom you bring your questions. The writer feels that he can introduce the curator without bias, because his own position, that of Research Associate in Anthropology, is at the foot of the ladder on the scientific staff, and his curatorial functions in Botany are strictly honorary and not executive. So these are the opinions of a disinterested onlooker.

Like the infant food of old, "we

are advertised by our loving friends." The American Museum of Natural History loves its Public, it exists for its Public, and to return to the simile, we are constantly striving to present visual instruction in its most attractive and digestible form for young and old alike.

Anyone who knows the Museum can see what a splendid job its Department of Education is doing; Dr. Russell, Chairman of that Department, and his staff of trained assistants are going far to lighten the load of the other curators. But I wonder how many beyond our granite walls realize the amount of time devoted to answering letters and receiving visitors.



AMNH photo

## How, Why, Where?

The inquiries come in by mail, by telephone, and by personal visits, and the curator is always happy to give the information, if he knows the answer. No one in search of knowledge is turned away, from the small boy who has found a funny looking rock to the man who thinks he has discovered a Rosetta Stone for deciphering the Maya hieroglyphics. But when a female visitor comes in with a miscellaneous lot of sea shells, and the expert spends precious hours classifying them, only to learn that the lady's little boy, caring nothing for conchology, needed the information for school points, the curator begins to wonder whether re-



search for Willy is strictly in his line of duty.

Then there is the Casual, who has an hour to kill and just dropped in to pass the time. And the more-to-be-pitied-than-censured introvert who is never given an opportunity to express an opinion at home; and the Tourist who has just returned from his or her first visit to Mexico and produces innumerable snapshots of Taxco and Cuernavaca.

Let no visiting student of any nationality infer from these remarks that he is ever interfering with business. He is always welcome to all the help the Museum can give him and must feel free to drop in and swap experiences and talk shop. The curator's hours would be drab indeed, if these visitors were denied him.

The Press has been more than kind in giving us the right sort of publicity and stressing our needs editorially. But occasionally we are visited by a member of the Fourth Estate who is impatient with the unspectacular character of our expeditions. A colleague, returning from a season in the wilds of Central America, was once interviewed by a reporter. When our scientist began modestly to relate some of the highlights of his journey, the interviewer broke in: "Listen, the public isn't interested in how you found a pile of old rocks and some busted pottery; what they want to know is how it feels to be chased across a tropical river by an alligator." My colleague had to confess that he had never experienced that thrill.

#### Breasting the Tide of Error

Surely every curator sometimes feels that much of his effort goes toward merely correcting false impressions or theories. A couple once registered their indignation that our Mexican and Central American Hall contained no exhibits of Atlantis or the "Lost Continent of Mu." Their indignation would, of course, have been stronger if we had taken space to show the truth about these romantic ideas.\* In the same hall a lady was quite scornful because our meticulously ac-

curate casts of the colossal Quirigua stelae and the Mexican Calendar Stone were not the originals.

At times the unforeseen may strain the resources of a department to its capacity. In 1910, the popular author Gene Stratton-Porter published a book called *A Girl of the Limberlost*. It was about a young lady who made a modest fortune by selling moths and butterflies to a dealer. She received the most alluring prices for them, in particular for *Eacles imperialis*, the Yellow Emperor. This novel was followed in 1912 by a nature book, lavishly illustrated, called *Moths of the Limberlost*. People throughout the nation suddenly became moth-conscious, and our Insect Department was so besieged with offers from amateur collectors that the incoming mail was piling up like snowbanks in a blizzard. Dr. Frank Lutz adopted an ingenious expedient. He prepared and placed in the foyer of the Museum a case containing specimens of the moths mentioned in the books with the dealers' prices then current—Yellow Emperor, 25 cents, Polyphemus, 10 to 15 cents, etc.

The bottom dropped out of the fictitious market, putting an end to dreams of sudden wealth and permitting our scientists to return to normal. The historic exhibit may still be seen, prices and all, in the Insect Hall.

#### The Flower that Never Was

The Museum belongs to the people of New York, and what they want we'll try to give them—if we can be sure of what they *do* want! Anyone in the amusement field will

back me up when I say that it is difficult to judge just what kind of entertainment will most appeal to the public. Special lectures and exhibitions have marked red-letter days in Museum attendance.

It is readily understandable that a lecture by Roy Chapman Andrews, telling of his expeditions to the Gobi Desert and the discovery of the dinosaur eggs, should have so jammed the auditorium that a repeat performance was necessary. And it is equally natural that when nuclear energy was a subject of the future, a movie on the Einstein theory of relativity produced a near riot, at which angry throngs bowled over the guards and stampeded into the lecture hall.

But am I to be believed when I state that the greatest attendance ever clocked at the Museum for a single day was recorded on November 4, 1933, when 40,484 people passed through our doors to see something which did not exist?

The occasion was the Autumn Flower Show of the Horticultural Society of New York, which was held in the 77th Street Wing. A false report had been circulated that a green rose was on display.

Those were the good old days when you didn't have to stand in line for a half-hour to get into a popular movie, when there were no cigarette shortages and no nylon queues. And yet that multitude stood milling in front of the building and around the block, vainly hoping to see a mythical freak of the vegetable kingdom which, if it *had* been produced, would have been an eyesore and an abomination!



\*See "Lost Continents," by L. Sprague de Camp, *NATURAL HISTORY* for May, 1946.

Drawings by  
Museum Illustrator's Corps

"A rose is a rose is a rose." Einstein or Gertrude? Can you blame the curators or any of the Museum authorities if they occasionally slip up in judging the public taste?

No matter how carefully exhibits are labeled and described, they are sometimes unable to counteract what the visitor brings in his own head. A few years ago, the visit of a world-famous child movie actress caused a flutter of excitement through the Museum. An escort was assigned, and in the Triassic Dinosaur Hall a paleontologist was describing to the child star the technique of hunting for the remains of ancient animals in the Gobi Desert. Her California tutoress, doing a little exploring on her own, spied in an adjacent exhibit the skeleton of a gigantic Brontosaurus—an animal that became extinct about 120 million years before the Age of Man. "Come here, dear," she called. "Look! The first animals domesticated by man. You know, 'Alley Oop.'"

#### **I Would Like to Join an Expedition**

If everyone who ever expressed that wish were laid end to end and were content to remain in that position, the curator's lot would be an easier one. But would-be joiners keep bobbing up, particularly when it is known that an expedition is being organized.

They fall into several categories. At the nadir stands the Problem Child. He seldom applies in person, usually through a maternal parent. Mothers can be trying at times. Before the days of civil service examinations, Theodore Roosevelt once appointed a singularly dull and inept young man to the diplomatic service. When asked why he had done so, the President replied with emphasis, "I had the alternative of appointing young X or of killing his mother on my doorstep." In our case, it would appear that the ewe lamb's individualistic talents are not appreciated at school and that the confines of the home and even of summer camps are too restricted for the play of a spirit so free and untrammelled by conventions. The desert wastes or the jungle fastnesses alone could

offer an outlet for his self-expression. Any expedition leader who, in a misguided moment, consents to take on one of these, may look for breakers ahead, and the consequences are none too happy for any of the parties concerned.

Next in line is the young man in search of adventure. No experience in field work in any branch of science but is used to roughing it. He thinks an expedition would be fun, and would even pay his way, if necessary. He is informed politely that exploring is a highly specialized and technical undertaking and that there is no vacancy for anyone except a scientist or an experienced hand.

In this category may possibly be placed the disillusioned businessman. Fed up with stocks and bonds, pestered by the "little woman," he wants to put at least 3000 miles between himself and Wall Street. Qualifications? Well, he might go as photographer. He took some extraordinarily good movies of little Lester toddling across the lawn at Rainbow's End. A polite thumbs down to him, also.

Next comes the serious student who has taken science courses in school with good marks and who wants to make a career of it. One cannot discourage a boy like this, but he has to be told that a few years spent in special preparatory study are necessary.

I would advise every would-be explorer to read Roy Chapman Andrews' book *This Business of Exploring* (G. P. Putnam's Sons, 1935). May I quote a few extracts from Chapter I, "Exploritis." "The explorer of today must first be a specialist. Thousands of men have applied for places on my own expeditions saying that they are 'good outdoor men' but have no special training. I cannot even consider them. They would be expensive luxuries . . . There is only one answer: Train yourself for a technical or scientific job which fits into exploration . . . Adventures, of course, are always associated with exploration. Yet they are the one thing that the real explorer tries to guard against. My favorite quotation is Stefansson's dictum, 'Ad-

ventures are a mark of incompetence.'" Which means that if you have prepared yourself adequately, you may cross a tropical river without the impetus of an alligator speeding you on.

Exploring is associated in the public mind not only with adventure but also with romance. Yet in practice it is an almost unremitting struggle between man and nature to determine which can outsmart the other, and it is often a difficult, unpleasant existence. A personal experience, not important in itself, may serve to illustrate the point. At the end of a tough season hunting for ruins in the Yucatan bush, R. E. Merwin and I came upon our greatest find, a magnificent and well preserved Maya temple. As we were laboriously hacking away with machetes at the trees and vines which almost hid the structure, Ray turned to me and said, "What shall we call it?" Without much thought I replied, "How about Pascua?" "Why Pascua?" "Because we found it on Easter Sunday." Ray grunted and said, "Why not call it 'Work-like-hell?'" Aching bones and itching hide usually dampen the thrill of discovery. There is not much romance in exploring except in retrospect.

#### **The Career**

The curator is frequently asked how one can become, say, an anthropologist. And, "Is there any remuneration in it as a career?" So many of these inquiries are phrased in the same terms that they might be form letters that teachers have given their pupils to send in. The curator is tempted to answer that it all depends upon one's definition of the word "remuneration." It has been said many times but still bears repeating that to succeed in any branch of science, granting the ability is there, one must have been bitten by the bug. If the bite is severe enough, you will become an anthropologist, a geologist, or a zoologist whether there is money in it or not. But it means three or four years of college and, if the virus is still active, one more year for an M.A. or three for a Ph.D.

When you have bagged your

sheepskin, there is a good chance that you may land a position in a university or a museum with a starting salary of from \$2000 to \$3500 a year, depending on the locality. Maintain a family on that? It's being done, and if destiny has shaped you for that niche, you'll find it a more satisfying spot than many a cushy pocket yielding pay dirt.

### Could You Please Tell Me?

*Queries come in, and believe me they vary.*

*What is the weight of an elephant's ear?*

*What shall I do for an ailing canary?*

*What is the mileage from Venus to here?*

*What is the dress of a Balinese dancer?*

*What is the sense of an Iroquois mask?*

*Buzz the Museum—we may have the answer;*

*We'll try to solve any question you ask.*

It would be impossible to estimate the number of questions that are posed to museum employees in the day's work. The vast majority of them show intelligent interest and thought. But once in a while one comes in that sticks in the memory when the others are long since forgotten. Here are a few examples.

"Please send me all the information you have on primitive man." In our library we have about 15,000 volumes on this subject. Every department is familiar with this sort of question. It even comes over the telephone, as, "Please tell me everything you know about fishes."

"How many redheads are there in the United States?" Statistics unavailable. Also, we must remember that not all the redheads were born that way.

"Would you mind sending me some data concerning undiscovered treasure in the Central American mountains. If possible, kindly let me know its general location. Thank you."

A research worker called up to ask about man's use of petroleum two million years ago, and could she have photographs of animals that lived at that time. Even the ape man began to walk erect something less than half as long ago as that, and *Homo sapiens* did not put in an appearance until several hundred thousand years later.

"Did man 100,000 years ago have a better, equal, or poorer sense of smell than civilized man?" Documentary evidence being lacking, we might say that he perhaps smelled *more* if not better.

"Please explain an elephant's trunk." Answer: Elongation of the nose, also used as a hand. "But why?" One of those evolutionary things; it kept on growing and became prehensile like the tail of some monkeys.

"Can animals predict the weather?" No, except in the immediate future. Some animals are known to sense an approaching storm, like grampaw and his rheumatiz. This is an interesting question. There is an old established belief that animals, by various manifestations, do predict the weather. The birds and bats that seem to be starting south ahead of schedule, the neighbor's horse that has put on an extra-heavy coat, the squirrels that are unusually industrious in collecting their hoard, even the trees that bear an abundant crop of nuts and pine cones, all are looked upon as forecasting a hard and early winter. And at the approach of spring, "Ground-hog Day" furnishes perennial copy for the newspapers. But there is nothing known to science that would support any of these beliefs. If there were, the weatherman would probably include on his staff a corps of peripatetic naturalists.

A young woman artist came in one day to see our bee specialist and explained with some diffidence that she had been commissioned by an advertising agency to make a picture of a bumblebee sitting in an armchair. Her question was what posture would a bee assume under the circumstances. It was our scientist's considered opinion that the bee, being a social insect,

would recline with the same aplomb on an overstuffed chair as on a rose petal.

A research worker called up in all seriousness to ask if a parrot had ever been successfully crossed with a flying fish. The curator replied, "No, not even with a parrot fish."

One lady reported that she had a female canary which was not mated but had laid 22 eggs in the previous six months. When out of her cage, the bird tried to build nests on the mantelpiece and in other parts of the room but always retired to her cage to lay the eggs. Question: "How can I stop her laying eggs?" The lady was advised by our Associate Curator of Birds to get a congenial mate for her canary, which would probably then settle down to a humdrum domestic existence, build her nest in the cage, and lay her eggs where they belonged. How could a psychiatrist improve on that advice?

A boy about seven years of age, in a very tense state, barged unannounced into the office of the Associate Curator of Fishes, his fist clenched. Opening his hand, he disclosed a tiny and thoroughly dehydrated fish and exclaimed bitterly, "Why is this guppy sterile?" It developed that he had removed it from his school aquarium and, having taken it home to his own container, was disgusted that it had not forthwith produced a colony of baby guppies.

In contrast to this was the assignment of the same curator to make a complete survey of all the game fishes and game fishing facilities of the coastal waters of North Carolina.

### The "Museum Piece"

The Museum receives a variety of curious offers. This one comes from our general files: "Sir, I beg to ask you whether you have interest in buying an old horse shoe which I found during an excursion under the barn of Rip Van Winkle's house in the catskill mountains in the year 1903 . . . I am to go to sell this old and rare document of the first emigrants of the U.S.A. at a moderate price."

(Sure that excursion wasn't under the Headless Horseman's barn?)

Offered for sale to the Museum's Library: "Nature Musine of History, New York. Dear Gemerman: -I am writing you on a book my mother have. It is the old Elementary speling book."

A lady came into the Library to ask if we had any books on "human parasites." She was not satisfied with what our books on entomology provided, for she was interested in the people who started life as insects and turned into human beings. When this possibility was questioned, she protested that she had seen one with her own eyes, a woman on a street in Colorado who was "very peculiar looking and had obviously begun life as an insect."

### *The Technical Expert*

To indicate how diverse are the Museum's services, I submit the following samples. The New York State Conservation Commission recently seized a bear which it claimed had been illegally shot, since it was in their opinion less than a year old, the legal limit. In order to establish their claim, the authorities sent the bear to the Museum to have the age expertized. The Department of Mammals easily confirmed the conservationists' contention that this was a "bear of the year" and that the hunter didn't have a leg to stand on. They were prepared to appear as witnesses if the case ever came to court.

A trained kangaroo once entered an elevator in one of the municipal buildings in a Mid-west city. The elevator operator, not seeing its long tail, closed the door too soon, injuring the animal fatally. The trainer of the animal brought suit against the city for an extremely large sum. One of the American Museum's experts on kangaroos was summoned clear from New York to testify how valuable or replaceable the animal might have been to its owner, who exhibited the kangaroo professionally as a boxer. Our scientist demonstrated on the witness stand how a kangaroo "boxes" naturally when approached by someone who knows how to

make the most of the animal's normal reactions. He convinced the court that the world had probably not lost a Jack Dempsey of the kangaroo world and also that even "educated" kangaroos should not be allowed in public elevators without competent escort.

One of our curators, an expert in physical anthropology, is not infrequently called upon, like King Solomon, to settle questions of paternity; and he has other unusual commissions relating to identification. To mention but one, a little girl in the Bronx disappeared, and when some charred bones were found in the furnace, the superintendent of her building came under suspicion. The fragments, all of which were exceedingly small, were sent to the Museum for analysis. Our specialist established that, though some of the pieces were from animals, others were undoubtedly human, and he was even able to determine the age of the individual. His findings led to the conviction of the suspect.

The curator is something more than a guide to the exhibits and an answer man. His duties are manifold. He is responsible for the care and the building up of the collections in his custody, not only the material on exhibition but the vast amount stored in special quarters for study purposes. Part of his time is devoted to field work, and there is a great deal of research to do on his finds after he returns home. He has various scientific papers to write, and some lecturing and teaching. Then, too, there are the services to scientists who come from other parts of the world to consult him and to study the collections.

### *Some Friendly "Don'ts"*

Therefore, if you wish to help ensure the even functioning of the curator's mental processes, may I offer a few suggestions.

Don't call the curator on the telephone and pose questions without first trying the encyclopaedia and the *World Almanac*.

Don't try to get him to write an article for which you get paid and he doesn't. He has his own compositions to draft.

Don't ask him to come to your office to give you information, and when he suggests your coming to the Museum, exclaim: "But I haven't time for that!"

Don't instruct your secretary to "contact" the curator, and when she gets him, keep him hanging on the line for five minutes or more until you are ready to speak with him.

If you are engaged in solving a crossword puzzle, don't call up the Curator of Mammals and ask him the name of a three-toed sloth in two letters, or a five-lettered African mammal of the giraffe family beginning with O. The curator knows the answers, but remember what it was that broke the back of the Bactrian mammal in five letters.

The curator usually lunches in the Museum cafeteria at 12 noon. If you are paying him a visit, unless you can accept his invitation to lunch, don't arrive at 11:50 and keep him talking until about 1:00 P.M. He may have breakfasted at 7:30 or earlier.

And the biggest "don't" of all: Don't hesitate to call on him if you are really stuck with a problem that is in his field. He will be only too happy to help you to the best of his ability.

Although there stands in one of our halls the skeleton of Barnum's original Jumbo, we do not subscribe to the opinion of the great showman that "the public likes to be fooled." The intelligent visitor knows that we are presenting more than a "stuffed circus" or a side show of preserved freaks. There is a gradual evolution in exhibition technique; and in holding the mirror up to nature we try increasingly to reflect accurately and dynamically the world of nature and to provide the maximum of education and enjoyment with the minimum of "museum fatigue," physical and mental.

The man I have been describing is an essential and very human cog in the mechanism of a well-run museum. With these random sketches I have tried to provide a glimpse of his activities. Mr. and Mrs. John Q. Public, Miss Jane, and Master Johnny, meet the Curator.





# GIANT *fly*

Most of the large horseflies you commonly see would look like pigmies beside this Titan of the Peruvian jungles with a wingspread of *three inches*

AMNH photo

By JOHN C. PALLISTER

IN the great Amazonian Basin and extending into the forests of Central America, the West Indies, and even Paraguay is an unusual family of flies known as the Pantophthalmidae. Some of the largest known flies belong to this group. About twenty-five species of them are known, and they resemble giant horseflies. Nearly all are attractively marked with gray and black stripes; the wings are mottled, and the abdomen is frequently banded with or colored a conspicuous red. The accompanying photograph shows one of them procured on a recent entomological expedition of the American Museum of Natural History in the tropical jungles of Peru near the little village of Tingo Maria.

The wanderer in the jungle will

▲ THIS HUGE INSECT is a true fly of the genus *Pantophthalmus*. Attention is directed to the balancing organs, or "halteres," just behind the base of the wings. On top of the head between the separated compound eyes are seen the three simple eyes that are found in a number of fly families


occasionally see one of these flies resting in a spot of sunshine on the trunk of a tree or on the leaves of some forest shrub. They are very wary, however, and when you approach one of them, it takes off with a terrific *whr-r-r*. The eye can scarcely follow it as it circles for a moment overhead and then is lost in the treetops. It is this wariness that makes these flies difficult to capture, and the insect collector has to stalk them with patience and dexterity. Probably this is why they are not very abundant in insect collections in the large museums.

Each fly appears to select an individual territory which it patrols. It rests upon some convenient perch ready to dash forth and drive away

any passing insects. The adult flies, from what we know of the life histories of a few of the species, apparently do not eat anything, because their mouth parts are atrophied.

The female (shown here) inserts its eggs into crevices in the bark of trees by means of the long ovipositor. When the larvae hatch, they bore into the trunk of the living tree, which is quite unusual for fly larvae; they apparently feed upon the sap as they bore. There seems to be some evidence that the larvae of some species require more than one season to reach maturity.

When full grown, they work their way out to the surface, pupating at the exit of the burrow.



▲ THE SKY was hung with webs of wild geese

## When the Blues

AS far as the eye could reach, to north and south, the sky was hung with webs of wild geese.

I had heard old men, telling of an earlier time, say they had seen the air full of waterfowl from horizon to horizon, but I had never seen it happen before. Now it was literally true.

Geese were coming up from the south in long curving lines, broken V's, irregular bars and wedges, one flock behind another with no break in the traffic. As far down the sky southward as we could see, they were flowing up over the horizon, drifting on like far-off wisps of smoke. They were flying high, just under the canopy of gray overcast, and from each passing flock musical flight clamor floated down to us like the belling of distant hounds, yet marked by the peculiar clear resonance that is born only in the throats of wild geese.

In the north each flock was breaking formation as it arrived, joining an eddying cloud of wildfowl that settled slowly earthward like autumn leaves. There was the destination, the landing place of the flight; but as the arriving birds circled lower and lower, fresh recruits continued to pour in overhead, so the confusion in the air remained unchanged, as it had for the last two hours.

It was a wildlife spectacle the like of which I had never seen before—one that is staged only at a

Knifed by raw March winds . . . cramped and shivering for hours . . . Would it happen? Suddenly there it was—the greatest wildfowl flight in all of North America

By BEN EAST

*All photographs by the author*

certain time and place on this continent.

This was the spring flight of the Blue and Snow Geese, the waveys of wildfowl hunters, up the Missouri River in mid-March. Nowhere else in North America is there a waterfowl trek to match that spring migration of the wavey legions.

Since before noon Jack Kennedy, a Council Bluffs newspaper photographer, and I had huddled in a deserted duck blind on the shore of a small slough on the river bottoms in southwestern Iowa, a few miles north of the Missouri border. So far we had had no chance to use either the movie camera or the bulky, long-range still camera that were our major reasons for being there.

A raw March wind whistled around the corners of the blind, rattling the fringe of dead reeds that were left from the camouflage of the previous autumn, knifing with whiplash sharpness through our heavy clothing. For an hour I had held my teeth locked together to keep them from clicking.

All the same, it had been far from a tedious wait. The wavey

flight was in full swing, and for hours the movement of geese had been continuous and steady.

The Iowa conservation officers who were helping us with the job of filming the migration had estimated the evening before that there were at least 100,000 geese resting on the ice of Fournays Lake, a mile to the north of the blind where we were now hidden. Certainly we had watched half as many more come up the flyway since noon.

"There'll be a quarter of a million geese here tonight if this keeps up," Kennedy predicted.

Now a feeding flight started off Fournays Lake. Birds by the thousands, earlier arrivals that had come up the day before or that morning, lifted from the ice and poured out toward the big river-bottom cornfield a quarter-mile beyond our slough. They flew low with no pretense at formation, an unbroken ribbon of geese. Above the cornfield they milled like chaff above a giant threshing floor, each goose on his own and for himself, their clamorous honking a din that hammered at our ears.

Out of the circling mass an end-

# d Snows go North

less stream of geese came spiraling slowly earthward, "funneling down," as old rivermen say, into the corn. They formed a tall cloud of birds shaped like the spout of a tornado, reaching from the ground a thousand feet aloft. Across its top the funnel was a half-mile wide. But as the geese made turn after slow turn, winding down the invisible stairway of the sky as if sucked earthward in a gigantic whirlpool, they narrowed their circles. Where the tip of the funnel touched the corn it was no more than a hundred feet across.

Off in the north we could see an occasional flock drifting southward, traveling very high, like skeins of dark beads strung across the gray sky. These were venturesome birds that had left Fournays at daybreak, eager to get on with the spring flight. They had pushed north to the next ancestral stopping place along the flyway, but finding there no hint of open water, they had turned and come back to an area where the ice was opening in the sloughs and where waste corn in the fields lay free of snow.

The waveys made a great wildlife pageant in the sky, a heart-lifting spectacle worth traveling a thousand miles to see. Yet Kennedy and I were not quite satisfied. After all, we had come to take pictures of the flight. Geese traveling 5000 feet above the earth may thrill the eye, but they are not good subjects

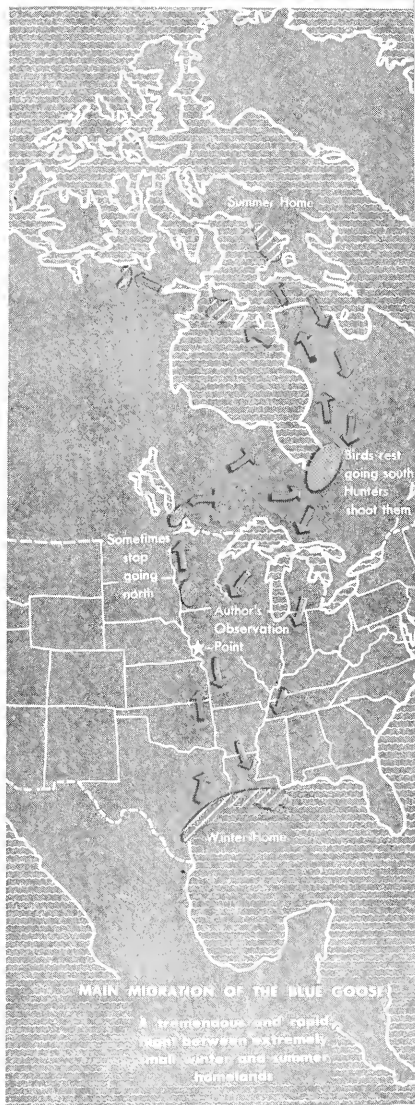
for the camera; nor do geese dropping down to feed a quarter-mile away provide good pictures.

While we crouched in the blind, hoping fervently something would rout the birds from the corn and send them our way, the haze overhead thickened, and the first wet flakes of a March snowstorm slanted down.

Then, faint and far away, we heard the roar of a plane. It was hidden in the haze of the northwestern sky over Nebraska, but the sound of the motor grew steadily louder. The clamor of the geese increased, and suddenly, with a thunder of wings that reached us clearly in the blind a quarter-mile away, a flock of perhaps 10,000 waveys sprang into the air as one bird. They lifted out of the corn in a dense black mass, apparently convinced to the last goose that they were safer from this unseen menace a-wing than grounded.

The roar of the plane passed overhead and faded in the southeast. For a few minutes the geese continued to circle above the corn in a huge compact cloud. Then the leaders turned our way and began to slant down, and we realized we were to get our wish. They were coming to our slough!

The first birds came floating in and settled on the ice at the far side of the slough a hundred yards from the blind. Others came behind them in an unbroken ribbon,





▲ GEESSE milled and settled on a frozen slough

➤ THE TAKE-OFF from the slough



sloping into the wind, wings set, feet trailing; and the flock built up with incredible speed.

It spread out from the shore of the slough as if someone were unrolling a dark rug, covering the ice with a living blanket of geese. They were coming in low over the blind, flowing down—slate-gray, white-headed Blues and milk-white, immaculate Snows—so close we expected every second to hear shrill cries of alarm and see the whole flock go flailing up from the ice. But each oncoming wavey had the all-clear signal from those already grounded. This place was safe, they sensed, else the others would have learned it by now, and the lure of the huge flock building on the frozen slough was too much for their gregarious instincts to withstand. Not a goose bothered to look down into our blind as they came over; not one paid the slightest attention to the tumble-down structure of boards and rushes or to the two dun-coated men who crouched under its sloping roof.

Our cameras were busy now, the lenses poked through openings in the front of the blind. We worked fast, knowing this close-up spectacle might be of brief duration, but between shots we took time to watch the descent of the great flock to the ice.

The nearest geese were passing no more than ten yards above us, their wings sounding like the rushing of a soft wind. We could see their eyes as they came over, see them crane their necks and pick their landing spot, see the thick gumbo of the Missouri cornfields clinging to the trailing feet of many of them.

In ten minutes the landing was finished. Ten thousand birds, as nearly as we could estimate then and afterward, had come down out of the snowstorm. The slough was all but covered with geese, and the nearest were no more than 50 feet from us.

A small channel of open water split the ice directly in front of our blind. For the geese this seemed to mark the dividing line between danger and safety. They stood ranged along the rim of the channel on the far side. A few slid into the water, picking up odds and ends of submerged weeds from the bottom of the shallow slough. They showed no hint of fear, but none ventured to climb up on the ice on our side of the channel. That, apparently, was as close as they chose to approach the shore.

The noise of the flock died down to a soft gabbling murmur. A few birds stood resting with one foot drawn up, like farmyard geese.

Others walked slowly back and forth, preening their wet feathers. Here they were, wild geese, wariest of the wary, forever suspicious of man, resting and preening as unconcerned as if they were safe on their polar nesting tundras 3000 miles away in the north, where man almost never comes. Even as we huddled in the blind and watched them it was hard to believe the scene was real!

The wet March snow continued to settle down, whitening the ice, turning the geese bedraggled and unkempt, but they paid no heed.

The waveys are used to snow. They migrate north on the heels of the retreating winter, their summers are spent beside waters that are rarely free of floating ice, and they come south again only when the storms of autumn will no longer permit them to loiter in the sea meadows of the Arctic.

The Blues are known to nest in only three places, on Baffin Island, on Southampton Island, at the upper end of Hudson Bay, and in the Barren Grounds just south of King William Island. The Snows breed in a polar landscape equally forbidding, along the northern rim of the continent from Baffin Island to Alaska, and on ice-fringed islands beyond the mainland.

In September, when Arctic storms

begin to sweep across their bleak tundras, and their fresh-water pools are sealed by ice, the geese leave their inhospitable summer homes on the first leg of the long fall flight.

All the Blues of North America and all the Snows that nested or were hatched in the great Hudson Bay basin funnel down the treeless coast into James Bay. Here, on the initial lap of the autumn migration, they encounter for the first time since they went north the previous spring the men and guns they are destined to face all down the long flyway. Their nesting places are too far in the north, too isolated in the polar fastnesses, for even the Eskimos to find them save on infrequent occasions. But once the flight starts, the geese move back into the country of hunters and begin to pay their annual tribute for the right to use the air lanes.

They meet the Eskimos first, hunters as skilled as any they will face on their journey south. Shooting for food and not for sport, the Eskimos use chunks of driftwood or a bundle of willow twigs with a white rag tied to one end for decoys. They lie hidden in tall grass above the beach or wait behind low stone walls and call the waveys to the guns with faultless mimicry.

Farther south, at the foot of James Bay, the geese gather on their ancestral pasture grounds in the salt marshes, to feed and fatten for a month to six weeks before renewing the flight. There they make contact with the next group of primitive hunters to whom the wavey migration means food for the long winter ahead, the nomadic Cree Indians.

Killing is a trade with the Crees as long as the geese remain there.

The Indians go out from Ruperts House and Moose Factory to the marshes on Hannah Bay and around the mouth of the Hurricanaw and Moose rivers, camp there for two or three weeks, and kill an average of at least 200 to 300 waveys per family for the brine barrels. They build tiny low blinds of willow brush on the open salt meadows,

spade up squarish lumps of blue mud for decoys, and call the geese down with a skill that a white hunter finds close to incredible.

It is in the salt marshes of James Bay that the geese also meet the first of the white sportsmen who await them all the way to their wintering grounds. The birds loiter on those northern pastures until the sharpening cold and storms of late October push them out.

A Cree hunter described the exodus to me as we stood in front of our goose camp on the Hurri-

high above the fields of Michigan and Wisconsin, drifting along in big flocks of 200 to 500. They keep the slanting lines and broken wedges that characterize migrating Blues and Snows, their mellow flight talk reaching down to quicken the pulses of earthbound humans.

The path of the waveys from the lower end of James Bay to their wintering marshes on the Gulf is direct and true. They leave the salt meadows of the north, fat and ready for migrating. The urge to complete the long autumn journey




canaw last autumn: "One day the marsh full of waveys. That night snow come, water freeze. Next day geese all gone, marsh empty. No wavey left."

That is how the flight south from James Bay gets under way—with spectacular suddenness. The salt meadows and the willow-bordered muskeg ponds empty in the course of a single morning. Later that same day, or perhaps the day after, the waveys are seen flying southwest,

is strong in them, and unless fatigue or the hazards of bad weather force them down, they make the flight in long stages, with a minimum of delay. They pass across the United States from the Canadian border to the coast of Louisiana on an airline course, over the Great Lakes to the Mississippi, and down the valley of Ol' Man River to their destination. And the belt of their flight is relatively narrow.

In the coastal marshes of Louisi-

◀ THEY FLEW IN 30 feet above  
our blind



ana and eastern Texas they settle down for the winter rest, the Blues limiting themselves to a restricted range in Louisiana, the Snows more widely dispersed.

In March, when winter is beginning its slow retreat, the spring flight gets under way. It is leisurely in the extreme, and this time the waveys do not choose the shortest and most direct route. They pass overland from the Gulf to strike the Missouri bottoms just below the Missouri-Iowa border, moving north in easy stages as the ice goes out and feeding grounds are freed of snow.

Sometime in April, depending on the schedule of the advancing spring, they reach Lake Winnipeg. There, 800 miles off their true course, they change direction, turning due east to James Bay. For the most part they pass up the autumn pasture grounds around the mouths of the Hurricanaw and Moose and so avoid the Cree hunters who thin their ranks in fall. The Crees of Moose Factory and Ruperts House rarely get good wavey shooting in spring. Most years they get none at


all. Farther north, however, other Crees and the Eskimos are ready once more with blinds and decoys.

The geese turn northward up the east coast of James Bay and Hudson Bay, to disappear finally into the polar wastes. Not before late May or June do they reach their nesting grounds.

The flight up the Missouri is guarded with all the thoroughness that a wildlife concentration of such

magnitude requires. From the time the geese leave their winter resorts until they cross the Canadian border, they are convoyed and watched over 24 hours a day by a specially assigned corps of federal game agents and state conservation officers from the sections they pass through.

The officers follow the flight as it moves north, throwing a cordon around each place where the waveys rest, using boats and cars, planes and radio, wallowing on foot through the Missouri River gumbo to protect the birds from poachers. The spring shooting that took a heavy toll on this stage of the flight up to very recent years is ended now so far as the waveys are concerned. The outlaw hunters have put their guns away reluctantly, resigned at last to the fact that the odds are too long against them. The great migration moves from the Gulf to Canada without losing more than a handful of birds to illegal hunting. No more intense and effective job of wildlife protection has ever been done anywhere in North America.



▶ A FEW SWAM back and forth  
in the water



## CAN ANIMALS REASON?

*Continued from page 116*

nearly correct to say that science studies problem solving rather than reasoning. It is doubtful if any professional experimentalist would stick his neck out so far as to answer a simple "Yes" or "No" to the question, "Can animals reason?" Instead he asks himself what kinds of problems animals can solve, and he places particular emphasis upon the ways in which animals work out their solutions. Birds have shown practically no indication of being able to solve problems in any way except by simple learning. Even the fabled crow turns out to be incapable of passing a reasoning test. All mammals demonstrate the ability to vary their attack, but the only problems that cats, horses, and even dogs can solve without previous practice are so elementary that the behavior scarcely qualifies as reasoning. Monkeys and apes turn in a better score, and some of their reactions are so reminiscent of human reasoning that the same term seems applicable to both.

### **Parsimony Preferred**

Some readers are probably saying to themselves, "Humph! My dog does things that are much more intelligent than simply piling boxes. Those skeptical psychologists in their artificial laboratories know very little about the natural behavior of animals. Why, if they could only see Towser . . .!"

Perhaps so. No experimentalist is so presumptuous as to think he knows all there is to know about animal psychology. However, before you jump to conclusions, remember the limits of our definition of reasoning. Be sure that the situation represents a genuine problem that has never been encountered before. If Towser looks the matter over and then proceeds at once to the correct solution, score him high. If he keeps making the same mistakes over again and only gradually improves, credit him with learning but not with reasoning. Between these extremes the analysis is not so easy. The fewer the trials and the more sudden the success, the better the excuse for invoking rea-

soning. It is not a hard and sharp line, but from the scientific point of view, the most parsimonious interpretation is the correct interpretation. Problem solving that can be explained as a product of chance or of gradual learning is not to be accepted as evidence for any higher type of mental activity such as reasoning.

And there is one more precaution, so important that it can hardly be repeated too often. *Keep your heart out of this.* Always try to form your opinions on the basis of what you actually see, not what you want to believe. Those of us who love pets frequently let our emotions rule our thinking in judging animal intelligence. A dramatic illustration of this human failing came to light a few years ago when one of the mass-circulation magazines published an article about the intelligence of horses.

The article was short and obviously intended as a humorous piece. The author simply described one funny incident after another which, so he claimed, proved that under some circumstances a horse can behave as though it hasn't a brain in its head. Just why this offended a lot of readers is difficult to understand. Surely the same thing could be said of human beings. Nevertheless, offend them it did, and indignant letters poured into the editorial offices.

The editor became alarmed and published a nicely worded apology to horses and horse lovers everywhere. "The article," he explained sorrowfully, "had been printed as entertainment, not as an official pronouncement on the limitations of the equine mind." He was very, very sorry that so many people (and horses?) had had their feelings hurt. In closing, he printed a few of the letters he had received. The point of this story is that not a single one of the published letters contained any evidence whatsoever to refute the original claim that horses are unreasoning beasts.

The letter writers pointed out the obvious fact that horses have served man for thousands of years. They called to mind the horse's willingness to labor faithfully for

the meanest kind of reward. Inevitably there was a letter about the horse who saved his master's life by finding the way home through the traditional blizzard. A young girl complained fretfully that the original article had brought ruin to her plans for owning a pony. By months of feminine strategy, she had convinced her father of the feasibility of her scheme, but when he read of the low intelligence of horses, he withdrew his consent.

Now what in the world do these letters tell us about the horse's *intelligence*? Not a thing! Suppose you were a schoolteacher and found it impossible to promote some child simply because he lacked the native intelligence to do the daily assignments. Would you revise your opinion just because someone pointed out that he was a good boy, never told lies, always said his prayers, and minded his mother? In forming daily judgments about the reasoning ability of our human friends and associates, we do not ordinarily rely on character references, but that is exactly what these letter writers offered to back up their fond belief that horses are highly intelligent. Just character references.

We know that men and women can be faithful, friendly, trustworthy, and lovable without being highly intelligent. In fact, we consciously differentiate between these qualities and sheer intellectual ability. Surely it is neither unfair nor unfeeling to insist that the same discrimination be observed when it comes to judging our animal friends. And when this essential rule is followed, we are likely to arrive at the conclusion that man can reason and does so occasionally, that his primate cousins show faint glimmerings of similar ability when they are carefully tested, but that for all other species the record is not encouraging. At this stage of knowledge, it would be premature to state flatly that dogs, horses, cats, and other four-footed creatures are totally incapable of reasoning; but thus far every objective search for scientifically acceptable proof has been completely unsuccessful.



# The *Cat* and the *Crawfish*

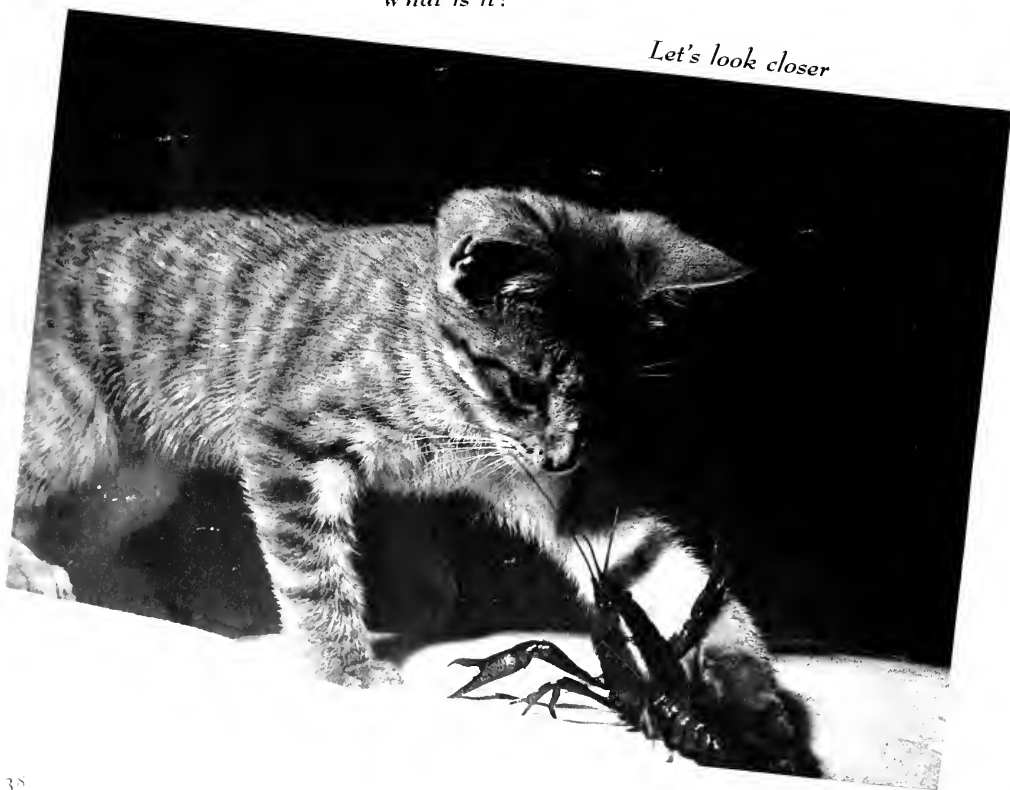
The photographic record of  
a kitten's reactions to an un-  
familiar creature that also  
has claws

By J. M. HOOD

*All photos by the author*

*What is it?*

*Let's look closer*





*Here! Here!*

*OUCH!*





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**"LONG-EARS" FAMILY**

*Continued from page 119*

The young were roused from their frozen positions, and a moment later an adult perched on the edge of the nest. After this first scare, the adults seemed to consider the flash only an unavoidable inconvenience. In the many nights that followed, they obviously lost all fear of this man-made lightning.

On my first visit, the nest contained three young, along with one pipped and one unfertile egg. The fourth infant, which hatched that night, remained the runt of the family for some time. Its development was slow, and after about 20 days it disappeared entirely. I naturally thought that this puny one had fallen to the ground to become the food of some predatory animal, but when the others reached the age when they began to hop from branch to branch, I found the carcass in the nest, picked clean, devoured by brothers, sisters, and perhaps parents. Whether the bird had died naturally or succumbed to attack remains an unanswered question. However, years ago when I spent 96 nights in a barn owl nest, I found that cannibalism often eliminated the unfit or the youngest birds of the brood.

This study on the "Long Ears" entailed a vigil of nineteen nights, averaging about six hours each night. A small six-volt light was kept burning about 20 feet away;

hence I was able to list accurately all the food brought in by the parents. During this time they delivered 40 gophers, 10 wood rats, 23 pocket mice, and the partial remains of 9 other small mammals. Feathered prey was entirely missing.

These observations on the "Long Ears" were completed just before our entry into the Pacific war. San Diego was then a quiet town and did not extend across the near-by mesas and into their wooded canyons. But now the population has doubled, and things have changed.

At the end of hostilities I revisited Tecolote. Instead of finding the owls for which the canyon was named, I found empty cartridge cases every few feet. And, of course, with fewer owls there has been an increase in the rodents upon which the owls formerly fed. Every few weeks the local papers stress the fact that typhus-infected rodents have been caught and that the "unexplained" increase of rodents can mean a disastrous plague. Tacked on the fences and on the trees that were frequented by the owls before "target practice" eliminated them there are now cardboard signs that say, "Beware—Rodent Poison." To my mind, poison is a poor substitute for a natural check on rats and mice and an expensive way for us all to pay for the one-second thrill enjoyed by the trigger-happy "sportsmen."

**BOOKS**

*Continued from page 102*

discussed at length. There is a list of references for those who wish to probe beyond the scope of the present work.

The sections dealing with the different groups are subdivided into brief general summaries of the more important features of the group. Among the features of this work are the unusually good photographs of live specimens that illustrate every species included. These depict the important features of each adult animal, as well as the young of many turtles.

Mr. Conant is well known for his scientific studies and his popular accounts of amphibians and reptiles, as well as for his capable editorship of *Fauna*, the quarterly magazine of the Zoological Society of Philadelphia. He has been eminently successful in producing a highly readable, scientifically accurate, popular treatise

that fills a need of the amateur and professional alike. A single, completely illustrated reference work covering the entire amphibians and reptile fauna of the northeastern states will be used more often than the usual "keys."

JAMES A. OLIVER.

**WING-TIPS**

----- by Roland Green

Adam & Charles Black, London  
(Macmillan & Co.: New York agents),  
\$1.75, 64 pp., 56 drawings

IN the author's words this little volume is intended for those amateur bird lovers who "often look with wonder at birds in flight and wish to know more of how they fly and why their flight differs so much with different species." Roland Green's accepted skill in bird portraiture

finds its best medium in scratchboard and pen-and-ink drawings like those filling more than half of these pages. Among the more artistic of these drawings are glimpses of a heron rising from a marsh and of a trio of eiders banking above the ocean. Sometimes a number of species have been grouped together to compare their profiles in flight, but even then the effect is usually pleasing. The text is an extended commentary on the illustrations.

The mechanics of flight are analyzed first, including such topics as rising, alighting, gliding, and soaring. Variations in the shape of the wings and tail as related to specialization for a particular type of flight are demonstrated. The recognition of birds by their flight is considered next. The text occasionally belies the theme of the book, for sometimes more is said of color pattern than of flight. For example, the white wing bar of the Common Sandpiper is mentioned but not the very distinctive flight of this species, which is like that of its American cousin, the Spotted Sandpiper. The reviewer found that migrant Common Sandpipers in the Philippines were most easily identified by their flight.

After reading *Wing-Tips*, even the experienced student of birds will observe their flight with greater insight and appreciation. Although written in England, more than half of the birds mentioned also occur in America. Many bird lovers will consider the illustrations alone worth more than the modest cost of this book.

DEAN AMADON.

## INSECTS AND HUMAN WELFARE

----- by Charles T. Brues

Harvard University Press, \$2.50  
154 pp., 14 illu.

THIS revision of the 1920 edition does much to elucidate the close and intricate relationship between man, his agricultural and forestation economies, and the ever-present insects that influence directly or indirectly his activities and livelihood. The book is designed with the purpose of making the public aware of the importance of entomology. Throughout there are concise discussions of the major problems that have confronted mankind and the manner in which he has met the challenges from the insect world. For example, the author stresses the battles man has waged against the insect-borne diseases, such as malaria and yellow fever; the battles against enemies of agriculture, such as the grasshoppers, the cotton-boll weevil, and numerous others. Insects affecting the forest and their importance to the many industries dependent upon lumbering are given considerable emphasis. It is impossible to calculate the number of lives or the man-hours lost as a result of insects and insect-borne diseases, but it is undoubtedly very great

## The Armchair Hunt



By EDWARD DEMBITZ

WITHOUT moving from your chair, you can try your luck at tracking down the more than 30 animals gathered in the figure below. They come from all corners of the earth. Some creep, and some run; some swim, and others fly. The largest is many thousandfold heavier than the smallest. To find them, form their names from the letters by starting with any square and then moving to an adjoining square in any direction, including diagonally. In any word you can come back to a square you have already used. Twenty is an above-average score. For our list of 31, turn to page 144.

A	L	M	K	S
T	O	I	N	P
G	B	O	R	H
A	S	E	C	A
S	P	E	L	T

indeed and probably more than anyone suspects. It appears that fully ten per cent of our agricultural production is annually destroyed by insects. Figures covering twelve products over a period of ten years (1930-1940) show that loss from insect attack amounted to some \$1,104,400,000.

Dr. Brues takes a commendable stand in discounting the prevalent rumors and predictions concerning the probable invasion of many formidable tropical diseases into this country by way of returning war veterans. There is little to justify such predictions, especially since there is much inherent in the diseases and the insect carriers that would preclude such a possibility.

It is unfortunate that illustrations of at least the major insect offenders could not have been included.

MONT A. CAZIER.

## THE RUFFED GROUSE—

Life History, Propagation, and Management

- - by Gardiner Bump, Robert W. Darrow, Frank C. Edminster, Walter F. Crissey

New York State Conservation  
Department, \$10.00  
915 pp., 131 illu.

IN the foreword to this generous volume, Mr. Perry B. Duryea, Conservation Commissioner of the State of New York, makes the statement that the Ruffed Grouse Investigation, of which this a report, represents the most sustained and comprehensive effort ever made to study any single form of North American wildlife. It seems hardly open to dispute. Since

the inception of the work in 1930, no pains have been spared to carry the study into all lanes that opened. The original five-year project expanded into a thirteen-year one. The report was ready in 1942, but wartime exigencies delayed its final appearance.

Only a firsthand examination of the volume can reveal the wealth of detail it contains. More than a million records have gone through statistical sorting machines to clarify the data presented in the 186 tables and discussed in the general text.

The Ruffed Grouse has shown many periodical fluctuations, and there has sometimes been such diminution in its numbers that fears were felt for its eventual survival. The primary problem of the Investigation was, therefore, to determine the causes of the fluctuations and suggest remedies. No single cause appears to have been responsible. Minor fluctuations of local importance appear to be the rule, and the major, widespread phenomenon seems to result from the simultaneous occurrence of the lesser declines. The causes of the local disturbances are examined in detail.

Artificial propagation has been developed to a certain extent, but it will have to be perfected before it will be of material assistance in restocking areas on a large scale. Land management is needed on privately owned grouse covers to give the birds the best possible encour-

agement to maintain their own numbers. Conservation measures are examined in detail.

There are important chapters on the physiology, anatomy, pathology, parasitism, predation, plumage, molt, taxonomy, and, of course, appearance, life history, and behavior. Some of these are by collaborating authors not listed on the title page. The colored plates are by Fred Everett, and the interesting and often amusing vignettes by Mr. Everett and Clayton B. Seagears. A bibliography of 405 titles and an extensive index add to the value of the work.

There are, admittedly, things still to be learned about the Ruffed Grouse, but the present volume materially reduces the task ahead. Everyone interested in this fine bird will want to have access to this vast fund of data.

JOHN T. ZIMMER.

## CAMPING CAN BE FUN

- - - by Robert W. Weaver and  
Anthony F. Merrill

Harper and Brothers, \$3.00  
241 pp., numerous spot drawings

HERE is a lively little book with excellent advice for all who enjoy camping experiences. It is well organized and crisply and entertainingly written. The material includes advice on select-

ing camp sites, preparing one's bed and shelter, fire building and cooking, knapsack packing, essential equipment, proper woods etiquette, and a worth-while chapter: "Grab Bag of Camping Incidentals."

The chapter entitled "The Well-Planned Trip Is Best" discusses this all-important topic with clarity and conviction. There are also descriptions of camping opportunities in various sections of the country, with useful information concerning the requirements of different localities. The authors have obviously camped a great deal, and their expert sharing of knowledge results in a decidedly useful, nicely illustrated book that should be in every camper's possession.

There are several opinions and statements relating to the capture of wildlife with which this reviewer does not agree. These considerations by no means interfere with the value of the book as a whole, and it would be doing the prospective reader and the authors an unwarranted disservice to place undue emphasis upon them. With the rising cost of living, many persons may discover that the only way to enjoy an inexpensive vacation will be to shun tourist accommodations and take to the woods with their own equipment. There is nothing particularly difficult about camping—experience will prove this fact. "Camping can be fun," and this book will help to make it so.

WILLIAM H. CARR.

## LETTERS

Continued from page 101

*Yarbwoman*, that appeared in *Harper's Magazine* twenty years ago, and it may have been put to other literary uses. Even without such bolstering, word of mouth is sufficient to maintain the existence of such yarns, despite the fact that they have been widely discredited in print. The implausibility of even one fatality from a fang in a boot is obvious to anyone having a knowledge of snake venoms and the venom apparatus.

The fang itself is little more than a highly modified tubular tooth, with a duct from the venom gland leading to the upper end of the tube. It is essentially like a hypodermic needle but curved. Muscles surrounding the gland contract around the spongy tissue of the gland, forcing the venom through the duct to the fang and out the discharge orifice near the pointed tip. Rattlers, and their allies among the vipers and pit

vipers, ordinarily drive their fangs into the body of their prey (or enemy) by means of a strike—a rapid thrust of the head, with the fangs raised almost to a horizontal position. When the fangs pierce the skin, the venom is forced through them.

The amount of venom thereby injected varies with the size and kind of snake. Only a drop or so from each fang is produced by juveniles of small species, whereas almost a fluid ounce has been extracted from a large red diamond rattlesnake. Snake venoms vary in potency, but at least a drop of even the strongest venom would be required to produce severe symptoms in a human.

What would happen if a fang were imbedded in a boot? This rarely happens since ordinary shoe leather is reasonably good protection from the bite of any but the largest venomous snakes. It is much tougher than the skin of the small animals upon which venomous snakes prey, and far more resistant than human skin. But suppose a fang did penetrate the leather and was broken from the snake's jaw. Only a small amount of venom, less than a drop, could possibly remain in the tubular portion of the fang, and none would be likely to adhere to the outside. The venom inside the fang might become dry and remain there. When properly protected, dried venom

does retain most of its potency even though it is modified by oxidation upon exposure to the air. But unless it be stored in some receptacle, it is subject to bacterial action and decay, losing its dangerous qualities.

Thus there is neither sufficient venom, nor any likelihood of its retaining its potency, were a fang to be left imbedded in a boot. By the same token, the efforts of various Indian tribes to poison their arrows with snake venom were undoubtedly fruitless, although psychologically the practice may have served the useful purpose of instilling fear in the enemy, as ethnologists have suggested. Stories of deaths from snake venom, whether from fangs in boots or from poisoned arrows, often are endowed with a more dramatic appeal than the simple facts. The writers of mystery stories may lament the impracticability of murder by such means, but surely there are an adequate number of death-dealing devices that might be substituted.

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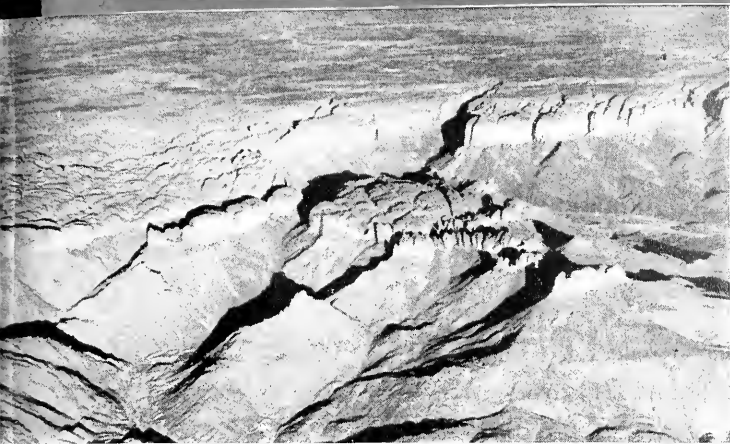
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WALTER F. WEBB

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◀ AN AERIAL PHOTOGRAPH of the canyon in the middle of the Sahara Desert, taken at an altitude of about 10,000 feet. The plateau itself is estimated to lie at an elevation of about 4000 feet

### **Sahara Canyon**

SIRS:

The accompanying photographs show an extremely large canyon in the middle of the Sahara Desert, which may not previously have been photographed from the air. Because the pictures will modify the general impression that the Sahara is an unvarying succession of beachlike sand dunes, I thought perhaps some of your readers might be interested in them. A canyon like this shows that erosion by water has been quite active in shaping the Sahara, even though it may not have been a consistent factor.

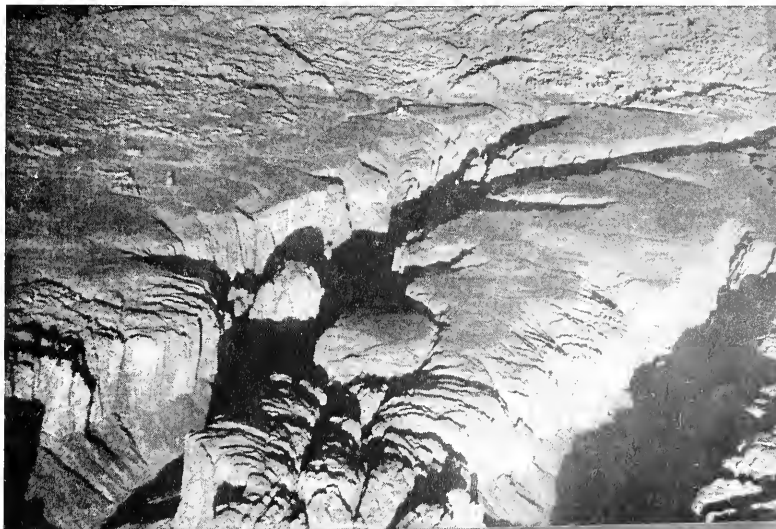
Because the photographs were taken at an altitude of approximately 10,000 feet, the canyon is probably larger than it appears. As nearly as I could estimate, the plateau at this point must be about 4000 feet above sea level, and the valley bottoms about 1500 feet less. So you can see that the canyon is a geographical feature of considerable size. Because of light conditions, it was impractical to photograph more than a small portion of the whole array. The coloring was confined to tan, fawns, and blacks, with nothing like the Grand Canyon's celebrated riot of color.

I took the photographs about a year ago on what was considered an exploratory flight from Johannesburg to Amsterdam by KLM. It was the second or third flight that carried passengers and was made to ascertain whether noticeable differences in flying conditions might be expected in this variation of the general route. As you know, nearly all airlines operating the length of Africa follow a course more or less along the east coast, because that side of the continent has far better facilities in every way and much greater concentration of population.

I have been reluctant to offer you these



▼ THE ROCKS are tan, fawn-colored, and black—less variegated than those of the Grand Canyon



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**YANKEE GOOSE FARM**  
Box 123, New Haven, Conn.

pictures because I am unable to identify the place exactly by name. My own interest in this curious phenomenon took me to the American Geographical Society, of which I have been an interested member for many years, and I have pored over many square yards of large-scale maps, mostly French, of the Sahara between the eighth and tenth longitudinal meridians. The canyons are approximately at the mid-point between Kano, in northern Nigeria, and Tunis, and from my study of the maps I have concluded that they must be located in the so-called Tassili-N-Adjier. This is at the northeastern perimeter of the much more lofty Ahaggar massif, which reaches an altitude of over 10,000 feet some distance to the southwest of Tassili. On the plane I carefully charted progress as well as I could. My notes show that the canyons are located very close to the relatively important Oasis Djanet, and the French maps support this view. B. DOUGLASS HARRIS.

New York, N. Y.

### San Clemente Sand Trees

Sirs:

In your issue for January, 1948, I was keenly interested in the observations of Lewis W. Walker as presented in his article, "Trees of Sand"; and I believe he would be interested to know that this phenomenon has not been confined quite as he believed to the islands of San Nicolas and San Miguel.

About 100 miles southeast of San Miguel, or roughly 40 miles east of San Nicolas, is the island of San Clemente. It is a wind-swept and desolate place, once occupied by Indians and very similar in many respects to San Nicolas. There, in 1914, several boys, including myself,

brought back many perfect *twigs* of sand, taken from a broad dune region from which many tree trunks of sand protruded. We photographed these, and they resembled very much the ones in the small-est illustration on page 16 of Mr. Walker's article. . . . GEORGE HUGH BANNING.

South Pasadena, Calif.

Sirs:

Last night I was reading the February issue of *NATURAL HISTORY* and was particularly impressed with the article "Tomb of the Weaver" by Earl H. Morris. His article brought me clearly to the realization that not only are the articles in your magazine highly informative and more or less unique, but they are generally written in the best literary style. I think that is especially true of this article by Morris. He is not only an outstanding archaeologist, but I think he has a fine literary style, which makes delightful and informative reading—in fact, this applies to the whole magazine.

MILO J. WARNER.

Toledo, O.

### Answers to "The Armchair Hunt" on page 141

Ape	Coat	Moose
Asp	Eel	Orc
Ass	Goa	Perch
Baboon	Goat	Racer
Bass	Goose	Rat
Bee	Hare	Robin
Bobolink	Leech	Serin
Carp	Lion	Skink
Cat	Lobo	Sora
Cera	Loon	Sprat
	Mink	

## MUSEUM EXPEDITIONS

### Morden African Expedition Has Returned

The first major expedition to the remote Turkana District of Africa returned to the American Museum of Natural History last month. Col. William J. Morden, veteran explorer and leader of the Museum's Morden African Expedition, described the Turkana as a tall race whose men average several inches more in height than American men and stated that the Turkana terrain in northern Kenya Colony is one of the world's most barren regions.

Col. Morden was accompanied on the expedition by his wife, Mrs. Irene Morden, who served as co-leader, and R. Kopler Lewis, anthropologist, who con-

ducted the first anthropological studies of the Turkana. He spent more than three months in daily contact with the tribe in their primitive little villages. Mrs. Morden, who studied the life of the women of the remote African tribes, is believed to be the first white woman ever permitted to study the Turkana.

Last April, the expedition left Capetown and traveled by car through Cape Province, Griqualand East, Natal, Orange Free State, Griqualand West, Transvaal, and Southern and Northern Rhodesia. There the cars turned back, and the expedition members joined their safari of four trucks, 17 native "boys," and two white hunters. The safari proceeded through Tanganyika to Kenya Colony. Headquarters were established at Lodwar in the Northern Frontier Province of Kenya. Later the expedition visited Zanzibar, Uganda, Buganda, the Belgian Congo, and the Sudan, covering a total of over 15,000 miles in Africa.

Lodwar is the administrative center of approximately 35,000 square miles of the

Turkana District in the Northern Frontier Province, from which some 75,000 nomadic Turkana are directed by three British officers. There are only four or five Europeans in the entire area.

The Turkana District is closed to foreigners, but the expedition obtained special permission from the Department of Native Affairs to enter and work in the area. In every instance, the expedition received the utmost courtesy and co-operation from all government officials with whom it came in contact.

The Turkana live on a semi-desert plain which is bounded on the east by Lake Rudolph and on the west by the escarpment of the Great Rift Valley. Northward are the Sudan and Abyssinia; to the south are the Kenya highlands.

The dress of Turkana men consists mainly of two or three ostrich feathers and an ivory plug worn in the lower lip. They also plaster the backs of their heads with masses of gray mud which is matted into their hair. The women wear beaded leather aprons fore and aft, many strings of ostrich shell beads around their necks, and several large rings in each ear.

The Turkana have no real tribal organization of their own but live in small family groups under the most primitive conditions. They have no housing problem, for their dwellings are simply a few branches of thorn trees stuck in the ground and covered with more branches. During the infrequent rains, they throw a skin or two over the top of the dwelling.

The examples of Turkana clothing, ornaments, spears, and other articles of everyday life which the expedition brought back have been added to the Museum's permanent anthropological study collections. Col. Morden stated that the expedition's comprehensive motion pictures of the Turkana tribe, the first ones ever brought to this country, would furnish an invaluable documentary record for future anthropological study.

### Expedition to Australia

Two field specialists of the American Museum of Natural History left New York Saturday, January 24, en route to Australia, where the Museum's first major Australian expedition is scheduled to go into the remote Cape York area this month. Geoffrey M. Tate, Manager of the New York Headquarters of Archbold Expeditions, and Hobart Van Deusen, of the Museum's Department of Mammals, were scheduled to join the other members of the field group in Cairns, a small coastal town at the base of the peninsula, during the latter part of February. Cape York is the northern peninsula that juts out to within 90 miles of New Guinea.

Other members of the expedition, Leonard Brass, leader and botanist, and Dr. G. H. H. Tate, brother of Geoffrey Tate and Curator of the Museum's Department of Mammals, have already met in Australia.

### EXPEDITION EQUIPMENT

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Creator God  
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Bottom Row **AMULETS** (left to right)  
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# LETTERS



## Ice "Poodle"

SMS:

In the February issue of *NATURAL HISTORY*, I noticed the picture of an "Ice Collar" sent in by James B. Cummings of Rochester, N. Y. The picture I am enclosing shows another peculiar ice formation taken by my naturalist father, the late Verdi Burtch of Branchport, N. Y., at Canandaigua Lake on February 2, 1936.

To me it looks like a huge polar bear or a large white dog resting on a round block of ice.

VIREO B. WHITAKER.

PENNY YAN, N. Y.

## The Threatened Sugar Pines

SMS:

In the February issue of *NATURAL HISTORY*, Dr. Willard G. Van Name brings to notice the urgent problem of including the extraordinary stand of Sugar Pines adjacent to the South Calaveras Grove of Sequoias in the plans to acquire the region for a state park. He is rightly perturbed about the danger that these giant trees will be logged, for the present disinclination of the Pickering Lumber Company to consider the sale of this tract of pines has led the state officials to abandon efforts to acquire it.

**NOTICE**—Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on these pages will be paid for at \$2.00 each, with full credit to the photographer. Return postage must be included.

It is possible that strong representation to Mr. A. E. Henning, Chief Division of Beaches and Parks, Sacramento, California, can successfully revive the interest of the officials in this aspect of the South Calaveras Grove acquisition program. Demonstration that the people want this tract preserved with the Sequoias, and that funds will be forthcoming to meet the cost, might well induce the company to reopen the discussion. Action must be taken at once, however, if it is to be effective.

Dr. Van Name is not correct, however, in stating that no conservation organizations have called public attention to this

problem. The first publicity it received resulted from a survey I made in 1942 of the entire area for the Emergency Conservation Committee, and many California papers carried articles and editorials at that time that stressed the importance of saving the giant Sugar Pines as well as the Sequoias.

The National Parks Association has stated its belief that acquisition of these Sugar Pines is equal in importance to the purchase of the Sequoias themselves. In 1942, a number of scientific and civic groups stated their position that these pines should be saved. There is no question but that the people of California, and the nation, can be aroused effectively to the seriousness of this aspect of the South Calaveras Grove project. It is a project that every conservation club and society should energetically support.

FRED M. PACKARD,  
Field Secretary.

National Parks Association,  
Washington, D. C.

Opportunity is taken again to define the area under discussion. Failure to identify it clearly can confuse the issue and endanger the effort to save the Sugar Pines referred to in Dr. Van Name's article.

The fact that some fine Sugar Pines are scattered among the Sequoia trees in the South Calaveras Grove is an additional reason for preserving it. But it gives no excuse for failure to save also the wonderfully beautiful tract of Sugar Pines closely adjacent to it on the north, which has been described as the most remarkable forest area in our whole country not al-

*Continued on page 192*

Photo by Fritz W. Neuhaus





# NATURAL HISTORY

The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVISON, President

ALBERT E. PAHR, Director

VOLUME LVII—No. 4

APRIL, 1948

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## THE COVER THIS MONTH

The Red Datura, *Datura sanguinea*, belongs to the Nightshade family, Solanaceae, a fraternity of such well-known plants as the tobacco, potato, tomato, and eggplant. Although various species of *Datura* are grown for their beautiful trumpet-shaped flowers, they are more famous for their poisonous seeds, which have been used as narcotics since antiquity. The Red Datura was esteemed as a narcotic at the Temple of the Sun in Sogamoso (Colombia) and by the priests of the Inca civilization of Peru.

The priestess Pythia at Delphi prophesied under the influence of *Datura* seeds, and they were also known to ancient Egyptians, Hindus, and Chinese. Narcotic seeds of the various species of the New World were also revered and used by priests as intoxicants and hypnotics. These included Jimson weed (*D. stramonium*) and Ololiuhqui (*D. meteloides*), both used by the Aztec priests. Veneration of the *Datura* still persists among modern Indians of our Southwest.

The Red Datura is quite unusual in its color, for most *Datura* flowers are white. This shrubby species is indigenous to the Andes of South America, from Colombia to Bolivia, but is often found cultivated in Latin America as a showy garden flower. The flowers on the cover were photographed in Bogotá, Colombia.

W. H. HODGE.

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Elizabeth Downes, *Editorial Assistant*.  
Atherlie E. Karp, *Editorial Assistant*.

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# YOUR NEW BOOKS

PLANTS • EUROPEAN POPULATION • PALOMAR  
FREDERIC REMINGTON • THE SCIENTISTS SPEAK

## EUROPE'S POPULATION IN THE INTER WAR YEARS ----- by Dudley Kirk

League of Nations, Lake Success, N. Y.,  
\$3.50—paper, \$4.00—cloth,  
303 pp., 56 figs.

THIS volume by Dudley Kirk is the fourth and last of a series prepared by the Office of Population Research of Princeton University at the request of the League of Nations. Like its predecessors, it deals with the present state and future prospects of Europe's population from a demographic point of view.

This study is, of course, a statistical one, and its richness of detail makes a summary impossible in a brief notice. One of the major lines of orientation, however, upon which many of the shifts in the balance of European population discussed by the author depend, is the decline of northwestern Europe as a reproducing center while eastern and southeastern Europe continue as an area of high natural increase. As a result, the proportional composition of European population is undergoing a considerable change in favor of the eastern and southeastern periphery. Furthermore, one sees western and northwestern Europe becoming an area of aging population in contrast with eastern and southeastern Europe, where the population has remained young. Thus not only are the absolute and proportional shares of Europe's population shifting eastward, but the available man power shows an accelerating balance in the same direction. It follows from this state of population balance that the migration pressure is the reverse—moving from the periphery to the centers of western and northwestern Europe where the demands of a dense, industrialized, and urbanized community are not being met by its own reproduction.

The trends of population growth, adjustment, and movement revealed in this important study are extraordinarily il-

luminating in the light of the recent events of European history. They represent the "set" of the basic currents of Europe's populations, which political and even military episodes seem to have little power to alter or to deflect. One cannot help feeling that the key to the predictable future of Europe lies in these trends which, curiously enough, receive scant attention in the vast flood of commentary on the state of European affairs.

HARRY L. SHAPIRO.

## THE SCIENTISTS SPEAK - - - edited by Warren Weaver

Boni and Gaer, \$3.75  
369 pp.

BEGINNING in May, 1943, a unique feature of the nationwide broadcasts of the Sunday afternoon concerts by the New York Philharmonic Symphony was inaugurated. Since the musical program was normally interrupted for ten or fifteen minutes near its mid-point, there was planned as an intermission feature a short essay on some important piece of scientific research. In this way, the latest developments in science have been clearly and compactly set forth for the intelligent layman in fourscore branches. Eighty-one leading scientists took part in this project, and their fascinating and authoritative stories, necessarily precise and concise, are included in this volume. The authors are introduced by Dr. Warren Weaver of the Rockefeller Foundation, who is responsible for the logical arrangement.

It is safe to say that the work of such an array of authors—the most distinguished scientists of America and in many cases of the world—has never before been brought together in a single volume or in any series of volumes. The list includes eight Nobel Prize Winners, the heads of several of our great universities, the most brilliant authorities of our leading astronomical observatories, as well as

the directors of research in a number of scientific foundations. Among other notable contributors to this book we find the names of Hubble, Russell, Shapley, Mees, Bethe, Urey, Oppenheimer, Arthur H. Compton, Karl T. Compton, and Langmuir. In the section on plants and animals, the American Museum of Natural History was represented by Dr. Robert Cushman Murphy.

The subjects are most intriguing, ranging from geology and astronomy through all the various kinds of research engaged in by our most distinguished workers. This is a most unusual up-to-date book, excellent beyond words to describe.

CLYDE FISHER.

## PHOTOGRAPHIC GIANTS OF PALOMAR

----- by James S. Fassero

Westernlore Press, Los Angeles,  
Calif., \$1.50  
60 pp., 28 illstrs.

THIS booklet by James S. Fassero consists of 60 pages, principally of perspective drawings of the 200-inch Hale and the 4-foot Schmidt photographic telescopes on Mount Palomar. There are brief descriptions by the author.

The artist, a colleague of the author, is Dr. Russell W. Porter, Astrophysicist of California Institute of Technology. The celebrated artist, Maxfield Parrish, describes this work as follows: "If these drawings had been made from the telescope and its machinery after it had been erected, they would have been of exceptional excellence—but to think that an artist had his pictorial imagination in such working order as to construct these pictures with no other material data than blueprints of plans and elevations—is simply beyond belief."

The "key drawing" reveals the general plan. It shows a meridian section through the telescope and dome looking west. It tells the story of the unique ways in which the 200-inch mirror may be used—as a coudé, a Cassegrain, or a Prime Focus reflector.

Separate drawings graphically present a detailed symposium of parts, structure, and complexity which volumes of words could not describe. The artist reveals in this work how scientific laws of stress and strain, translated into engineering



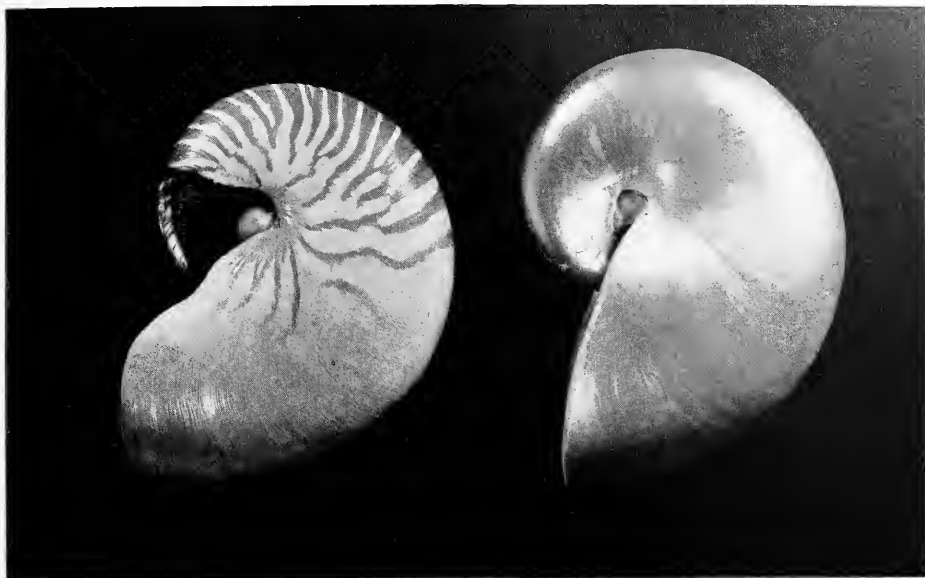
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And coral reefs lie bare;  
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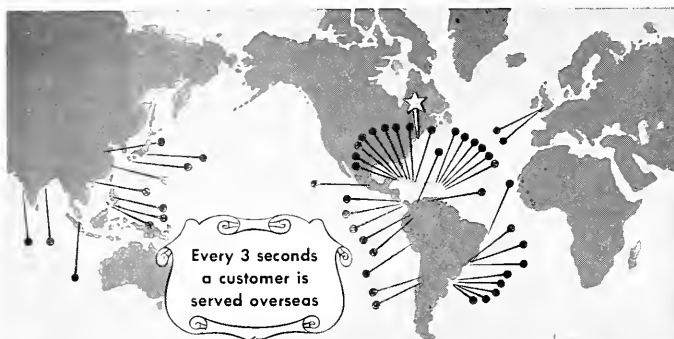
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GORDON A. ATWATER.

## BIRDS OF PREY OF NORTH-EASTERN NORTH AMERICA

- by Leon Augustus Hausman

Rutgers University Press, \$3.75  
164 pp., 32 illu.

**P**ERSECUTED by gunners and pushed back by the spread of civilization, many species of hawks and owls have decreased seriously in numbers. It is highly desirable that the beauty and wild charm of these birds, as well as their frequent value to man, become known to a larger segment of the public. This handsomely produced book appeals for the protection of the birds of prey and emphasizes their usefulness. Perhaps it even goes too far in repeatedly implying that they prevent meadow mice from reaching plague proportions, for it now appears that hawks, owls, and other predators are often "controlled" by the cyclic fluctuations of rodents, rather than the opposite.

The book gives a species by species account of the general life histories of the 30 kinds of Raptores known from the northeast. Often couched in somewhat more flowery language than one expects nowadays, these accounts make regrettably little use of the wealth of information published on hawks and owls in recent years. A few slips have occurred, such as the use of the same technical name for the two races of the Bald Eagle. A section intended to introduce the falcon family, to judge from the heading, was apparently omitted altogether and part of the account of the Gyrfalcon substituted by mistake. Each species is illustrated by a black-and-white plate by J. B. Abbot. Some of these are very attractive; others less successful. The colored frontispiece is by G. M. Sutton.

For the beginner or general reader this book will provide a brief and fairly accurate introduction to the birds of prey, but even the moderately informed bird student will find very little in its pages that is new to him.

D. AMADON.

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FRED J. PIERCE, Winthrop, Iowa  
NATURAL HISTORY, APRIL, 1948

## CAUSES OF CATASTROPHE

----- by L. Don Leet

Whittlesey House, \$3.00

232 pp., 80 illu.

THIS book, a selection in the \$10.00 Whittlesey House Fellowship Contest for Scientific Books written for the layman, is concerned with the more violent aspects of natural phenomena and with a nontechnical explanation of the known facts as to the "how" and "why" of their occurrence. Mr. Leet, who is the Seismologist in Charge of the Harvard University Seismograph Station, is one of the leading American students of earthquakes and their accompanying phenomena.

Four forms of natural catastrophes are discussed in detail: Earthquakes, Volcanoes, Tidal Waves, and Hurricanes and Typhoons. The reader learns of past occurrences, described in dramatic yet restrained language, something of how the records they leave may be interpreted, and much as to the underlying causes of these catastrophes.

When a work is as well written and authoritative as this one, it is difficult to venture to criticize it without seeming to carp at minor matters. Nevertheless, to this reviewer, at least, it would have been a better book had certain extraneous material been deleted from the chapter appropriately entitled "Mountain Making and Volcanoes in the Pacific." Matters such as an understanding of the International Date Line, or a log of a trans-Pacific flight, or the pronunciation of Japanese place names are undoubtedly interesting, but they do derail a train of thought with almost catastrophic results of their own.

The book is strongly recommended to all who are interested in this world on which we live; but it is suggested that Chapter 5 might be skipped until the rest of the book has been read. Then, by all means, go back and read it, too.

H. E. VOKES.

## PLANTS, A GUIDE TO PLANT HOBBIES

----- by Herbert S. Zim

Harcourt, Brace and Co., \$3.50  
398 pp., 121 illu.

DR. ZIM is the author of eight or ten books of this nature on various subjects, especially planned for the beginner in natural history. They are exceedingly

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well done. The material is carefully and intelligently selected, and it is logically arranged. The author knows how to tell a story. In fact, he is a born teacher.

Many books in this field have been written by mere hack writers, and they offend the naturalist who cares for trustworthiness. This volume, however, is a creditable achievement in the popularizing of botany. It is in no sense a textbook; it is the story of botany, told with surprising completeness and with a care for accurate statement that is heartening to any teacher. It is illustrated with 121 black-and-white drawings made by a botanist, and they have been well done.

The book includes so much of interest and help for one who is inclined to make a hobby of plants that it is impossible to give an adequate analysis in the space allowed. This reviewer is sure that the book is better because it was written by an amateur and not a professional botanist.

One is given a glimpse of the importance of identification and classification. Plant collecting is discussed, and we are told the story of the change and development of plants from the algae and bacteria through the fungi, lichens, liverworts, mosses, and ferns to the highest of the seed plants. We are shown the plants of the past, domesticated plants, plant experiments, and plant localities worth visiting. At the close of each of the 20 brief chapters there is appended a well-selected bibliography of a few books—a helpful addition. Upon reading this book, one can be sure that plant activities have always been fun for the author and that acquaintance with certain groups has led to enjoyable trips, vacations, and even afternoon walks.

CLYDE FISHER.

## OUR FLOWERING WORLD

----- by Rutherford Platt

Dodd, Mead Co., \$6.00  
278 pp., 56 illu.

HERE is another book by the author of *This Green World*, which recently enthralled naturalists and all lovers of beauty, and this is a worthy companion volume. Mr. Platt has the unusual facility of discussing a scientific subject in fascinating, nontechnical language. The

Continued on page 191

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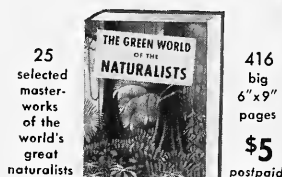
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▲ ON A MILKWEED PLANT there may be several hundred of the curious traps

► A CRANE FLY with its proboscis in one of the nectaries of the milkweed flower



THOMAS A. EDISON, wearing a long tan duster, appeared to be crawling from under a haystack that late August morning when I visited his red brick laboratory in quest of material for a magazine feature. Actually, he was climbing out of a Model A Ford, on the roof of which rose an immense mound of milkweed and goldenrod. He was experimenting at the time with native plants as a source of rubber. He had spent the morning with two young assistants driving along New Jersey highways collecting roadside weeds for his laboratory tests.

That glimpse of the odd sedan with the aged inventor climbing from beneath the high-piled weeds flashed through my mind one afternoon last July. All around me rose more than 100 milkweed plants. They were clustered midway down the slope of my Insect Garden—that ancient orchard acre where for a dozen years I have planted the annuals and perennials, the bushes and vines, that would attract insects

within range of my camera and magnifying glass.

The air, hot and still, was drowsy with the humming of bees. From a wide area, nectar hunters were flying to this small section of my hillside. The milkweed blooms were the goal of innumerable insects. Here were green-banded wasps, white cabbage butterflies, honeybees, crane flies, blue-black digger wasps, bumblebees, a monarch butterfly—flawless and brilliant, just from the chrysalis—small dark ants, wasps brilliantly banded with black and white, red-eyed little flies. *Halictus* bees, brownish skipper butterflies with silver spots that shone in the sun as they turned this way and that harvesting the nectar.

EDWIN WAY TEALE is familiar to most readers as a frequent contributor to *NATURAL HISTORY* and as one of the leading nature writers in the United States. He is the author of nine books, including *Grassroot Jungles*, *The Golden Throng*, *Near Horizons*, and *The Lost Woods*. Nature books of his have been

# The Milk

By

EDWIN WAY TEALE\*

*All photographs by the author*

In five minutes, I counted more than 100 insects on the milkweeds around me. A few were dining on leaf tissues; some, like the robber fly that was making its falcon swoops above the plants, were preying on other insects; but the vast majority were avid for nectar.

transcribed into Braille and translated into Swedish, French, and Spanish. Last year, Mr. Teale and his wife made a 17,000-mile field trip through 23 states to gather material for a book that will appear a few years hence, "The Milkweed Trap" is a chapter from a new book, *Days Without Time*, to be published in the fall.—Ed.





# weed TRAP

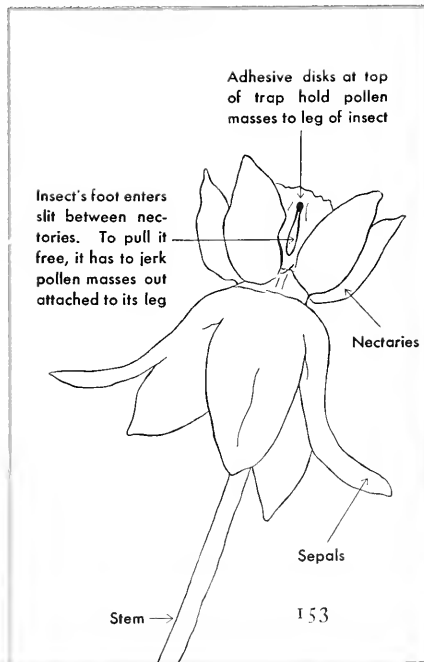
▲ CLOSE-UP. The insect catches its foot in the slit and pulls it upward in trying to escape. The black spot at the top represents the adhesive disks which hold the pollinia to the insect's leg when it escapes to visit another flower. No milkweed flower produces seed without this act

You would search far to find an event so fascinating as the operation of this ingenious trap, which anyone can observe at the right season wherever the common milkweed grows

Tinted to catch the eye, perfumed to delight the sense of smell, baited with five flagons of honey-sweet nectar, each separate flower in the colorful globes of the massed milkweed blooms was well calculated to attract and charm the nectar drinkers. More than 10,000 of these flowers awaited the visiting insects on the 121 milkweed plants my garden contained. Those visits and the drifting parachutes of silk released by milkweed pods in autumn are linked together as cause and effect. Slip a hood of gauze or netting over a milkweed plant to keep insects away during blooming

time and no seed pods develop on it. Although in the flower, stamens and pollen are but a minute fraction of an inch apart, they never reach each other without the curious and often hazardous intervention of an insect.

Close beside me, a golden-banded honeybee flew from a flower to the wide green landing field of a leaf. As it settled down, I saw that each of its six feet were tipped with brilliant orange. It tried to walk, and its effort was awkward. Its movements suggested an insect on snowshoes. One of the green-banded wasps rose from another





▲ A MONARCH, or milkweed butterfly. When such insects alight to sip the nectar, they run no danger. But small ones cannot pull themselves loose from the trap



▲ A MOTH that perished on one of the blooms

► THIS FLY has been caught in six of the milkweed's traps, adjacent flowers

flower. A foreleg was similarly tagged with orange. A few moments later, a small butterfly fluttered away from one flower clump toward another. I caught it in a net. Under my pocket magnifying glass, I studied the tiny orange rectangles attached to three of its feet.

They were held in place by a black, sticky disk arrangement, glued and clamped to the foot of the insect. Extending downward from this holding mechanism were two prongs, like two halves of a clothespin, ending in spade-shaped masses of brilliant-hued pollen. So tightly were these pollen masses locked to all six feet of a bumblebee which I carried home for closer examination that the insect bumped about inside a Mason jar for more than half an hour and yet dislodged the pollen from only one of its legs. Wherever the bee went, the pollen would go, too. But how did the milkweed flower attach it so firmly in place? What was the trap it used?

Half a dozen times, as I leaned close to the purple umbels around

me, I watched honeybees alighting on the flowers a few inches from my eyes. Each flower has a cylindrical center with five incurving horns or hoods, resembling fleshy petals, around its edge. They are horns of plenty for the alighting insects. Each is a floral flagon holding nectar.

As it alighted, each insect dangled from the flower and struggled to anchor its feet on the smooth sides of the cylindrical center. In so doing, it frequently found a convenient footing in the U-shaped lower ends of slits that run vertically up the sides of the flower. These slits are five in number. There is one between each pair of nectar horns. With one or more feet anchored in such slits, the honeybee would fall to work draining the five nectaries of the flower. The last sweet drop consumed, it would prepare to move on to another bloom. It is at this precise moment that the trap is sprung. It is then that the bill for refreshments, so to speak, is presented to the diner.

In the stirrup-like lower part of the slit, the insect's foot is comparatively free. But when it is lifted, it rises into a narrowing inverted V. At the extreme upper end, the foot slips between the black sticky disks and stops. The insect's leg is held fast. To pull it free requires a jerk sufficiently strong to tear loose from its pocket the wishbone-shaped structure bearing the two paddles of pollen. This pollen, unlike the fluffy dust of many blooms, is waxy, almost solid. The mass remains intact as it is carried through the air.

Riding with the insect, it reaches another bloom. The wishbone prongs, holding the pollen masses, dry quickly. This permits these masses to converge or become twisted together. When the insect struggles for a footing on the new flower, a leg that bears the pollen slips into another slit. Here the pollen is broken off and remains in contact with the sticky stigma at the upper end of the slit. Thus fertilization is achieved. This mecha-



nism of the milkweed is one of the most remarkable and complex in all the world of flowers, yet anyone can see it in operation wherever milkweed grows. Probably only among the orchids is its equal to be found.

The few flowers that are thus fer-

tilized undergo a rapid alteration, whereas all the others wither and drop to the ground. The stems swell and strengthen, and at their tips the tiny pods take form. As the pods increase in size, they turn upward, pointing their tips toward the sky. Then, in autumn days

when the plants are dry, the pods split open, and the brown seeds, overlapping like scales and each attached to a parachute of silken threads, are ready for release. The silk of the milkweed threads unfolds upward toward the tip and so is carried free. All of those drift-

plan: it reduces the chances of its success.

Yet all down the hillside, on this and successive days. I found wasps and beetles, gnats and crane flies, small butterflies and ants, moths, and various species of flies imprisoned on the milkweed blooms. Once I found a crane fly caught by its proboscis. Another time I came upon a bumblebee that had escaped with two clothespins of pollen attached to the stiff pile of its furry side. More than 30 of the tiniest ants of my garden were swarming over one plant in search of nectar. They ran about the flowers with impunity. They were too small to carry pollen and too small to get caught.

But many others were less fortunate. Some of these were alive and struggling. Others hung limp. They had died in the traps that held them. Some were imprisoned by a single leg, while others had all six limbs fixed in the slits between the nectaries. Some were anchored to one flower: others were the prisoners of more than one.

Near the lower end of the slope. I came upon a red ant stretched

out as though on a rack. Its first and second legs on its right side and its first leg on its left were locked in the traps of one flower, while its rear right leg and its middle and rear left legs were pulled back to the slits of another flower. They stretched like cables across the blooms. The two flowers moved together and apart, nodding and bobbing about as the ant struggled to get free. Whenever it drew any part of a flower within reach of its curved, clipper jaws, it



slashed about in a vain effort to bite its way to freedom.

Half a dozen other ants were also victims of the milkweed's trap. One dangled from a cluster of dry, withered blooms. It, too, when I touched it with the point of my pencil, was dry and lifeless. It had been there for many days. Yet the flowers, now devoid of perfume, their fountains of nectar dried up, their brilliant coloring gone, still clung tenaciously to the legs of their victim.

As the milkweed blooms lose their coloring, the black spots at the top of the slits, which show the position of the adhesive disks, stand out as clearly as ever. The flower fades, compresses, grows brittle. The five black spots, for a long time during this process, remain visible, the last evidence of the floral traps that play so important a part in the life of the milkweed.

◀ A MAGNIFIED VIEW of a single milkweed seed with the fine silky hairs that form the parachute which carries it through the sky



▲ THE SEEDS lie in a closely packed mass within the pod. In time, they all peel upward like the one shown at upper right ready to sail off through the air

◀ OTHER SEEDS follow the first few—a winged battalion to ensure a new generation of milkweeds

# MEXICAN *Portraits*

By HESTER MERWIN

Native types have appeal for both artist and layman. Last time we showed examples of Hester Merwin's work in *NATURAL HISTORY* she was depicting some of the last surviving Carib Indians along the historic route of Columbus. Since then she has traveled extensively in Mexico with her husband, Edward L. Ayers, and these portraits are a few of the many that have resulted from her intimate daily contact with the people



JOSEFINA RUIZ:  
twenty-two-year-old  
wife of serape (blanket) weaver.  
Zapotec Indian girl  
of Teotitlán del Valle, Oaxaca



A NATIVE of Oaxaca  
with mixed ancestry



ENRICO FERNANDEZ:  
nineteen-year-old Mixtec Indian youth  
of Tlaxiaca, Oaxaca

MIXTEC  
OF TLAXIACA  
OAXACA - MEXICO

"JUANA" LOPEZ:  
Zapotec servant girl  
of Peras Pueblo, Oaxaca



JOSE PÉREZ:  
Zapotec Indian  
of Ocotlán Pueblo, Oaxaca

NATURAL HISTORY, APRIL, 1948



ZAPOTEC  
OAXACA - MEXICO



ROGELIO GAVARA GONZALEZ:  
thirteen-year-old Miztec boy  
of Tomazola Pueblo, Oaxaca



CONCEPCIÓN:  
thirty-year-old *tortillera*, or tortilla vendor.  
Zapotec woman of Oaxaca

ISAURA LOPEZ:  
a Zapotec woman  
of Oaxaca





◀ FROM VANCOUVER ISLAND to California, the Pacific coast grows the largest burrowing clams in the world—the “goeeyduck.” They thrive along the line of lowest tide, particularly in the reaches of Puget Sound

▶ THREE GEODUCKS is the legal limit for one day. These have drawn in their necks as far as possible, but the white shells cannot close over the meaty “breast”—the most delicious part of the monster. The neck is ivory in color, the breast skin a reddish-orange suggestive of roasted fowl

HAVE you ever seen a man trudge happily along a dusty road, mud splashed on bare legs to well above the knees, and with three giant clams slung over his shoulder, their necks grasped in his clenched fists? It has to be seen to be believed—especially when the big bodies of the clams are bobbing against the middle of his back.

We thought we knew the clam tribe well. In the Gulf of Mexico, we had watched scallops snapping their valves and swimming through the water to escape from a starfish. The row of bright little eyes that showed between the parted shells was unusual. Yet we were not overly impressed. Quahogs and long necks left us cool as an oyster. All this was before we went goeeyducking. Now we feel very differently about bivalves. Here is what changed our minds:

A few days before we left for a trip through the Northwestern States and Canada, a photograph arrived showing four or five men hiding behind a half-dozen huge clams. Accompanying the picture was a note, telling us that these bivalves were “goeeyducks” and native to Vancouver Island, British Columbia. The exact location was not mentioned, nor was there any suggestion that the snapshot was the work of an imaginative cameraman. The picture appeared to be just an average shot made with a box Brownie. But we didn't believe our eyes! No clams could be *that* big!

By the time we arrived at the Pacific coast, we had partly for-

## WE GO

# Goeeyducking

You'd feel like Alice in Wonderland if this Gargantua of the clam kingdom were served you on the half-shell. The creature is hard to find, but this thrilling tale will convince any gourmet that the prize is worth the quest. Its meat is “delicious beyond description”

By LORUS J. and MARGERY J. MILNE\*

*Photographs by the authors*

gotten the goeeyduck photograph. Then one day we were chatting with a lighthouse keeper about the many kinds of birds that nested on the cliffs between his station and the sea. Oh, yes, there were several kinds of gulls and cormorants, sandpipers, and *goeeyducks*. The young ones had been unbelievably numerous only a month or six weeks ago. And cute! Why, we just should have seen those little goeeyducks!! To make matters more tantalizing,

our lighthouse keeper appeared to be an honest man—not one to delight in misleading tourists. We listened carefully, exchanging glances with each other that may have puzzled the civil servant, and then departed. What was a goeeyduck? Clam? Bird? Monster? Myth?

At the University of British Columbia we hunted up a scientist with whom we had corresponded years before. His field was fisheries. Surely he would know the truth

\*FOR THEIR ARTICLE “The Life of the Water Film” in *NATURAL HISTORY* for June, 1947, Drs. Lorus J. and Margery J. Milne received a special honorary award for distinguished science writing from the Westinghouse Educational Foundation and the American Association for the Advancement of Science. Both husband and wife are biologists at the Uni-

versity of Vermont and both have the same hobbies—photography and field trips. From 1942 to 1947, Lorus J. Milne carried on investigations of visual problems for the armed forces at Johnson Research Foundation in Philadelphia, while Mrs. Milne did research on sulfa drugs at the University of Pennsylvania Hospital and later taught at Beaver College.—Ed.



about gooeyducks. Yes, he admitted, he could show us the shells of a gooeyduck—they had a pair somewhere in the biology museum. It was a clam, then, not a bird. But the limy shells weren't very big, and we were disappointed. On the beaches of New Jersey we had seen shells as large as these. No, he hadn't seen a live gooeyduck for many years. There might still be some along the west coast of Vancouver Island, but no roads went into that region, and small boats were expensive to charter. The word was spelled "geoduck"—possibly from some Indian name—yet

was pronounced "gooeyduck."\* The scientific designation for the clam was *Panope generosa*.

We seemed to be on the right track. Or were we? Within recent times at least, the geoduck had been found within 50 miles of where we sat. But should we pursue the matter further? Were we following just another clam?

Our chief gain was in learning the scientific name for the geoduck. This could be a key to the literature. We went to the university

\*Webster's Dictionary also gives the pronunciation JEE-oh-duck and lists as well the words "gweeduc" and "goeduck," both pronounced GWEE-duck.—Ed.

library and got out all the books on seashore animals. Most of them made no mention of *Panope*. But in one entitled *Between Pacific Tides* (by Ricketts and Calvin) we located some new information. The geoduck was the largest known burrowing clam; it made its home in mudflats below low tide along the Pacific coast, especially in Puget Sound. The body was so huge that the comparatively small shells were unable to close over it, and the neck was long enough to reach from the clam's home (three or four feet down in the mud) to well above the bottom ooze. It really was a monster, after all.

On the east shore of Vancouver Island, we visited the Biological Station at Nanaimo. Surely that would be the place to ask for geoducks. The director was away, but other members of the staff did their best to help. Everyone was pessimistic. *Panope* had once lived near there, but all had been fished out. The most recent colony had been on Sydney Spit. Then some Sydneysites had formed a "Geoduck Club," with an annual hunt and chowder party. For a while they had a wonderful time. Then the geoducks gave out, and now there was neither club nor clams. Even the west coast of the island was not a very likely source. No one knew what place to suggest.

Two of the graduate students were native to those parts. They looked at each other knowingly, for in a beach not far away they had noticed clam necks of large size. Probably they were *Panope*. The boys would be glad to guide us to the spot and show us how to dig.

We arrived in a chilly morning mist to take advantage of the low tide and learn the special knacks required in geoducking. The students, clad in heavy sweaters and hip waders, shuffled along in the water's edge. Every so often one of them would point to a low bump on the bottom, where a few bits of seaweed clung to some object. Soon we, too, were identifying these queer mounds. The boys stuck a small stake in the beach beside each hump to mark the spot.



◀ **DIGGING TECHNIQUE.** The L-shaped board keeps the water from draining into the excavation, but it does not keep the oozy walls from caving in or the sea from filling the hole. This small gooseyduck was the reward for hard and hurried digging

▼ **PREPARATION.** First step is to sever the neck from the body of the giant clam



while we went on to inspect other areas along the shore. The supply of stakes far exceeded the number of clam necks visible, and since the tide was beginning to come in again, we prepared to dig.

The special "knack" required one of the students to make a quick grab with his partly closed fist, in an attempt to catch the half-inch of extended clam neck before its owner could recognize danger and withdraw into the mud. If the clam was too quick, the neck vanished in a geyser of dirty sea water that spouted a foot or two in the air, usually up a sleeve or in someone's face! Even if the fist got a good grip, the clam would struggle to free itself and often did so in less than a minute. It was up to the other boy to frantically clear away the mud with his shovel, exposing inch after inch of the clam's neck, producing a bigger and bigger hole in the beach and giving his co-worker a chance to get a better grasp on the neck itself. A foot or two below the surface of the mud, the bivalve came into view. Its chalk-white shell contrasted strangely with the inky ooze in which it lived, and the long neck, extending upward toward the supporting hand, suggested a length of low-grade garden hose.

Before the tide covered them up again, we succeeded in collecting four of the buried creatures. The rest got away in spite of our best efforts. The shells were quite as large as those we had seen at the University of British Columbia, but they were more rounded at the ends and enclosed the animal except for its neck. Certainly they

were enormous clams. We weighed the largest—it came to well over two and three-quarter pounds. Were these geoducks or not?

Back at the Biological Station once more, we displayed our trophies. The savants shook their heads. Not geoducks. These were Horse Clams (*Schizothaerus*)—much smaller than a geoduck and too scrawny to be interesting as food. See how the end of the neck was protected by two horny flaps that opened like a butterfly's wings to expose the siphon system, or closed like a trap to protect the sensitive openings. Between these gates, water went down the neck to the buried clam, bringing it both oxygen and microscopic food particles. A second canal in the neck brought the water and waste products back to the world above the mud and squirted them out in a quarter-inch jet. Geoducks didn't have those flaps; the neck tip was soft and projected even less above the mud. These Horse Clams even supported weeds and barnacles on the extended siphon armament; the neck of *Panope* was clean. And we would find the geoduck far too large for its shell!

So our score was a foursome of Horse Clams. Where was the more exciting geoduck? We would ask again in Washington State, as soon as we crossed on the ferry. Actually we inquired again at the Provincial Museum just before boarding the boat. No geoducks. Try farther south.

We asked the ferryboat captain about geoducks. And the steward. And the gasoline attendant in Port Angeles. And the policeman. Every-

where we went we inquired about geoducks, and we met all reactions from blank ignorance to vague recollections. Our search seemed futile. One ranger at Olympic National Park Headquarters recalled having dug and eaten geoducks as a boy. On a map he showed us the place. Surely some must still exist in Washington State.

Our wild geoduck hunt continued. We tried to visit the spot recommended by the ranger, only to find his island now private property and inaccessible. We told our troubles to the country storekeeper from whom we asked directions. Oh, geoducks. Sure, there were some of them around. He pulled out his watch. Why, it was low tide just now. And the Major had told

him this morning that he was going geoducking. We ought to drive down the road. Perhaps we could meet the Major and see some of the giant clams. But we'd better hurry. The tide would soon be coming in again.

Thousands of miles from home, how close were we now to the geoduck? Down the gravel road we tore, skidding on the turns, the car bouncing and rattling like mad. Into a private lane we swung and ground to a stop at the very edge of the steeply sloping beach. The tide was out for sure. And on the mudflats were a few people with pails and shovels. We had found the Major and his family. Had they any geoducks? Oh, yes, come on down and see.

Since a giant clam is in the same class as a fish story, we hastily shouldered our camera gear and

raced down the beach. The tide was already lapping at the stakes the Major had pressed into the ooze beside the geoduck necks he wanted to dig. But no hurry. Take all the pictures you want. First the 35 mm. color camera, then black and white. Next the Bolex with its 16 mm. film. Heaviest of all was the big 4x5, with our prized Bausch & Lomb Tessar lenses, low-reflection coated for those well-nigh impossible shots. Geoduckers, photographers, and tripod sank lower and lower into the oozy mud. The tide crept in little by little. Finally the digging commenced.

The Major had an L-shaped frame made from two half-inch boards. This he pressed into the mud just above a geoduck neck. Each wing of the frame was about two feet long, and he pointed the angle of it up the beach so that any water draining from a higher spot would be deflected to the sides and not run into his excavation. Then as his little circle of watchers strained to note every detail in the procedure, and the cameras clicked and whirled, the Major bent his ample back to the shovel. At the first touch of spade to soil, the geoduck neck vanished. A hole, two inches in diameter, remained to mark the spot. The shovel cut large chunks of soggy mud from the sheltered area, always to the low side of the geoduck burrow, and never disturbing it in any way. Down and down he dug. The oozy walls cracked and fell in. Patiently he cleared away the debris. Water rose in the excavation. His wife bailed it out with a bucket. Then, at a point directly below where the geoduck neck had shown originally, a creamy lump was uncovered. All eyes were on it, but no move was made to disturb the animal. Out came one shovelful of mud. Then another. A pailful of black liquid. More mud. More water. The dirt dropped away from inch after inch of geoduck neck. Still the hole went down.

The Major made the pit large enough to stand in and continued with his digging. Additional neck. More mud. More water. Three feet down. Three and a half. Four.

And then the clam itself came into sight. The shovel was laid aside, and two skillful hands reached into the ooze to lift the great geoduck gently from its home. The body was almost as large as a hen's, and the two dirty white shells clamped to the sides seemed ridiculously small compared to the bulk of animal. Their resemblance to wings was enhanced by the long, thick, rubbery neck that extended to one side. What a clam!! At last we were seeing a geoduck!!!

Two more the Major dug, this time seizing both from a single excavation dug halfway between the stake-marked necks. Each was a beautiful specimen. He showed us how to distinguish the "nostrils" (neck tips) from beach and how to tell a geoduck nostril from those of another type of burrowing clam, the Piddock, whose shells enclosed no such mass of delicate and delicious meat. Piddocks required just as much digging as did geoducks. But why go to all the trouble for something you didn't want and couldn't use? The Piddock's neck ends in twin volcanic cones, while that of the geoduck is blunt.

Then came a surprise. The Major wasn't going to dig any more. Three was the legal limit in the State of Washington. Three per shovel per day reads the protective law. And in all the year there are just 36 days when the tide is low enough to expose geoduck necks. Only a "minus tide" does the trick. Low tides vary, depending on how well or poorly the sun and moon co-operate in their gravitational effects, and on other things. So geoducks may be sought only three days each month. And only in summer do these special occasions occur in daylight. We had arrived on the last of the three days in July. Not for another lunar cycle could these clams be reached again. Fate must have smiled on our geoduck-ing. How else could we have chanced on the place, date, and delightful demonstration all together?

We followed the Major and his family to the house to watch and photograph them as they prepared the geoducks for dinner. None may be canned, we learned. The law

▼ THE SEVERED NECK is sliced open lengthwise and folded back. Then the skin is peeled away, yielding a block of muscles four inches wide, eight inches long, and from one-half to three-quarters of an inch thick. This will be diced and used to give flavor and body to the chowder





was written before deep-freezing came into vogue, so that holding some meat that way for winter use is legitimate. Only minutes elapsed between taking the monster clams from their snug homes in the ooze and placing the valuable parts in a frozen food locker.

First, the geoducks received a thorough washing in fresh water. The mud was rinsed away, leaving a thick ivory neck leading to the bulky body, clasped by the ineffectual white shells. Between the valves and opposite the hinge, the clam projected in a broad ridge of solid meat, whose surface color was an appetizing orange-brown, suggestive of a roasted bird. The Major referred to this as the "breast," and indeed it resembled that part of a chicken. No imagination was required to fit the geoduck into the pattern of a fowl. It lacked head, feet, and tail; the shells were not wings. But the illusion was remarkable.

Although the clam had drawn in its neck as far as possible, the firm mass of it still extended for a foot or more. With a sharp knife the Major parted the neck from the main bulk of the animal, slit it lengthwise, and folded it backwards to yield a block of solid muscle four inches wide and half to three-quarters of an inch thick. From parts that had been buried in the mud, the outer skin peeled away fairly well, but the siphon tip (blackened with pigment cells) was more horny and not worth saving. This peeling process, we were told, could be made easier if the neck were dipped for a moment in boiling water. Then the skin came off like that of a scalded tomato. The neck muscle would be diced and used in chowder.

Next, the knife cut through the bulging "breast" and severed the two strong muscles inside, with which the geoduck clamps its shells together. This breast meat is the mantle of the clam, a part that ordinarily protrudes but little. Yet, in this amazing animal, the mantle edge is enlarged and thickened into the most edible portion of the shellfish. The mantle of each geoduck yields four chunks of tender flesh

three inches long, an inch thick, and one and a half inches deep. Sliced thin in stews, it has a most delicious flavor, and like the neck, releases drops of golden oil that rise to the top like melted butter.

The rest of the geoduck is waste. The creamy tissue lining the shells (although mantle, too) is thin and useless. Two delicate gill plates on each side are scarcely thicker. And in the middle, supported from the hinge line of the shell, is the bulbous body, mostly stomach, with a small knob on the end. This section is swollen with loops of the digestive tract and is of no value to man. The button on the tip is the small foot, but the animal doesn't even use this to hold itself in its burrow. Apparently the geoduck is just too huge to move about. The site it settles on at an early age is a permanent home, and as the creature grows, it works a little farther into the mud and opens up a larger cavity around its enlarging body.

Fascinated as we were to meet and eat the geoduck (our newly found friends were long on hospitality as well as patience), there were many aspects of the big clam's life still veiled in mystery. "Where are the little geoducks?" the Major wanted to know. "How long does it take one of these huge animals to reach maturity?" "Where did the name come from?" To none of these had we any answer. But at least we had found the object of our long and curious quest. What else could we uncover while in the creature's homeland?

One point we were able to settle—a problem that had been worrisome to natives for many years. As each geoduck shell is opened wide, a three-inch "worm," transparent as lucite, drops out from the region just above the foot toward the hinge line of the valves. What is it? Upon close examination we knew it to be the "crystalline style"—a strange, pestle-like device that many mollusks have. This rod grinds itself away during digestion, providing an enzyme which helps to liberate the nutritious portions of the clam's diet.

Repair work on the car delayed us in Tacoma, and we used our

time to trail the geoduck in print. Gathering the giant clams is a "sport" fishery, so dates of minus tides and chatty descriptions of geoducking parties are a regular feature in the summer newspaper columns. One city park contains a most attractively maintained public aquarium, where geoducks and other amazing animals of the Pacific coast are on display. Apparently the huge bivalves are very local in their distribution. A colony may be no more than a dozen yards across yet contain from 60 to 100 individuals of large size, plus uncounted young.

Spawning of the geoduck takes place in late spring and early summer, but for several months the tiny clamlets swim in the sea and spread over a wide area. The following year the young resemble worms in the mud, and many are killed deliberately by clam diggers who do not know their relationship to the geoduck and think them unwanted, harmful residents of the beach. This is not surprising, since the animal is then from three to five inches long, with a cylindrical, wormlike body three-quarters of an inch in diameter. Even at this stage the shell cannot close. Each of the two valves is about the size of a man's fingernail, and the pair are hinged together to form a paper-thin saddle over the vital organs at the creature's anterior end. For the next four years, the young geoduck works itself deeper into the mud and gradually transforms into a more recognizable clam. Fifteen or sixteen years is not an unusual age for an adult to reach, but it requires an expert on bivalves to read the growth lines on any individual shell. Authentic weights of twelve pounds are on record, and since most of this is delicious meat, the geoduck is deservedly popular.

Apparently geoducks are often spared an untimely death because of the common Horse Clams and Piddocks near by. To many would-be geoduckers, these other siphon tips are indistinguishable, and a few false leads require so much time-consuming and wearisome digging that the tide slips back again before any *Panope* have been dis-



turbed. The Piddocks (*Zirfaea*) and Horse Clams (also called Caspers) are so much more common than geoducks that chance favors the latter kind.

Interest in the geoduck dates from the early days of the West. In 1881 and 1882, the United States Fisheries Commission tried to transplant to the Atlantic Coast the three most desirable bivalves of the Pacific shoreline. First among these was the geoduck, but the venture was unsuccessful.

By 1926, the digging of the big bivalve on the West Coast was so widespread that they were threatened with extermination. Then only Geoduck Creek on the west side of Olympic National Park would have remained to commemorate them.

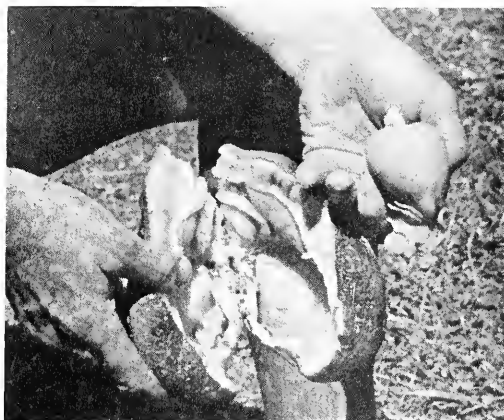
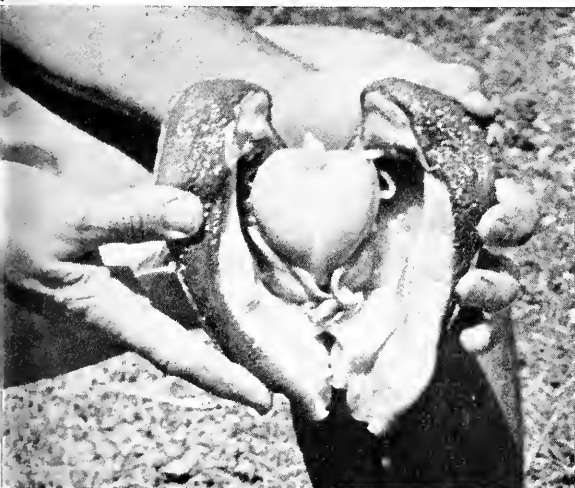
But the Washington State Legislature took the matter under con-

sideration, and in the records of that 1926 session can be found a source of retrospective entertainment. We would have missed the comedy had not an eyewitness drawn our attention to the story. Like so many amusing incidents that the taxpayer misses though he pays the full admission price, this one occurred as the representatives were anxious to adjourn and were dealing with a number of bills that stood between them and home. One after another these items were rushed through with little or no comment. Then came a bill to establish county libraries throughout the state, appropriating funds for the purpose. The expense was not large, but one representative asked for the floor and gave a thundering denouncement of such a wasteful use of public money. His remarks were received in silence, and

the bill passed anyway. Next on the docket was a bill to provide a closed season on geoducks. It outlined the need for protecting the unusual shellfish and furnished details of a program for ensuring its continued existence. A fair amount of money was involved. The same representative rose and requested permission to speak. In tones as full of portent as had been his comments on the county libraries, he extolled the virtues of the geoduck and demanded that this bill become law. Libraries were unimportant. But the geoduck—that was different. This bill passed too, and no geoducks were dug legally in Washington for several years. In 1931, the Legislature opened the season but placed the present bag limit, decreeing that the huge clams must be eaten fresh and that the only instrument with which they could

*Continued on page 190*

▼ THE "BREAST" is parted along the mid-line so that two stout muscles that clamp the shells together can be severed and the geoduck opened wide. In the center is the bulbous stomach, with a small foot at the end



▲ THEN THE STOMACH is removed and discarded



► BEST of the geoduck meat are the two large blocks of solid flesh from each side of the "breast." Usually they are sliced crosswise like a banana and heated with vegetables as a stew, or fried into "gooeyduck flakes." If cooked, they liberate a clear golden oil that rises to the top like melted butter. The flavor is delicious beyond description

WE GO GOOEYDUCKING

# *The Life Story* OF THE *Tent Caterpillar*

Little-known facts  
about a well-known insect

*Photographs by LILO HESS*

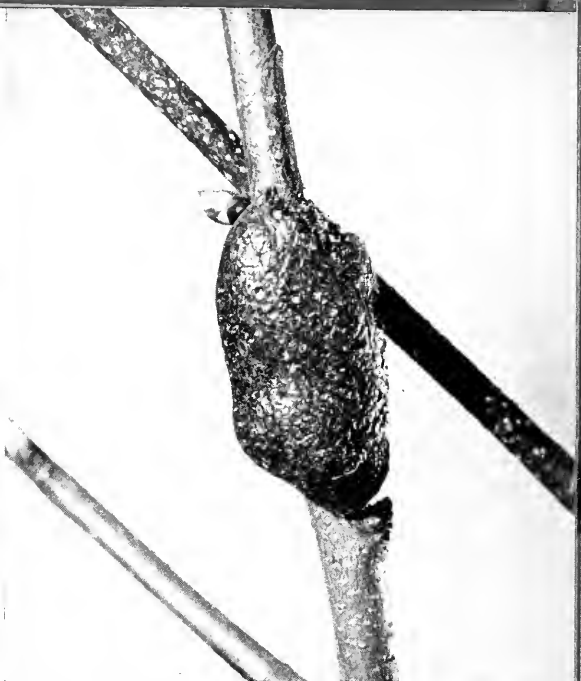
*Text by C. H. CURRAN*

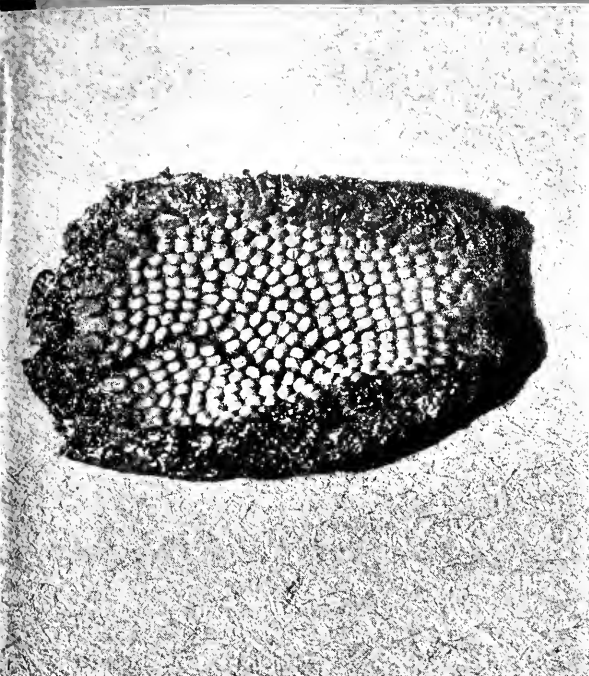
*Curator, Department of Insects and Spiders,  
American Museum of Natural History*

**4** FROM the day they are born, the caterpillars are makers of silk, weaving a single thread wherever they go. When they leave the egg mass to feed, they spin a silken thread so that they can find their way home. They find protection under the communal tent for the night

**1** DURING the fall, winter, and spring, when there are no leaves on cherry and orchard trees, the egg masses of the tent caterpillars form conspicuous brown rings on the small twigs. When the infestation is heavy, dozens may be seen on a single tree

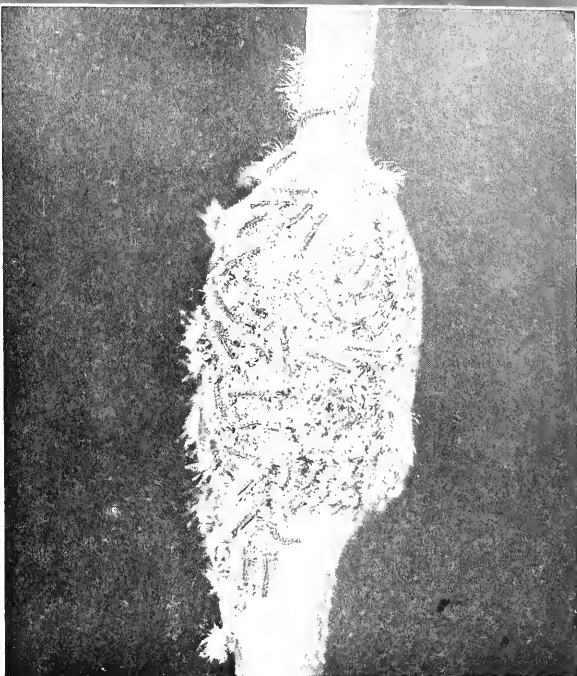
**5** AFTER A FEW DAYS, the caterpillars find a suitable fork in the branch of the tree and construct a miniature "tent" in which to spend the night. As they grow older, they enlarge the tent; or they may desert it and select a better site





**2** CLOSE EXAMINATION of an egg mass shows that under the coating of shellac, deposited by the mother moth for protection during the winter, there are 300 to 400 eggs arranged in somewhat regular rows

**6** AS A RULE, the caterpillars follow each other from the "tents" to the feeding areas. The leader spins a single silken thread, and the others do likewise so that, as they move along, the twigs become white and mark the way to the dining areas



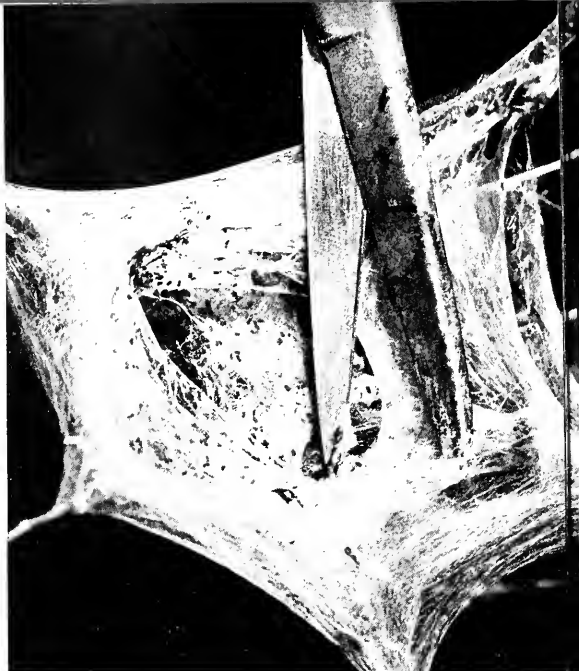
**3** WHEN spring days arrive, the warm rays of the sun incubate the eggs, and from each one crawls a tiny, slender caterpillar, its body covered with long, light-colored hairs. Some of them take their first meal from the egg shells from which they hatch

**7** ALTHOUGH the tent caterpillars often occur in enormous numbers, they have many enemies, one of the chief ones being the Fiery Hunter, a member of the ground beetle family. At night and on dark days, the beetles feast upon the tent builders





8 THE FIERY HUNTER is a voracious feeder. Once it has grasped a victim, it chews incessantly, and within a few minutes only the hairy skeleton remains



9 If you open the tent with a twig or a pair of scissors, you may see little on the inside, but if the inhabitants are home . . .

12 IN THE SPRING, the shiny green leaves of the wild cherries are one of the refreshing sights of the countryside. The end branches produce the freshest and most conspicuous greens of the budding season, but . . .

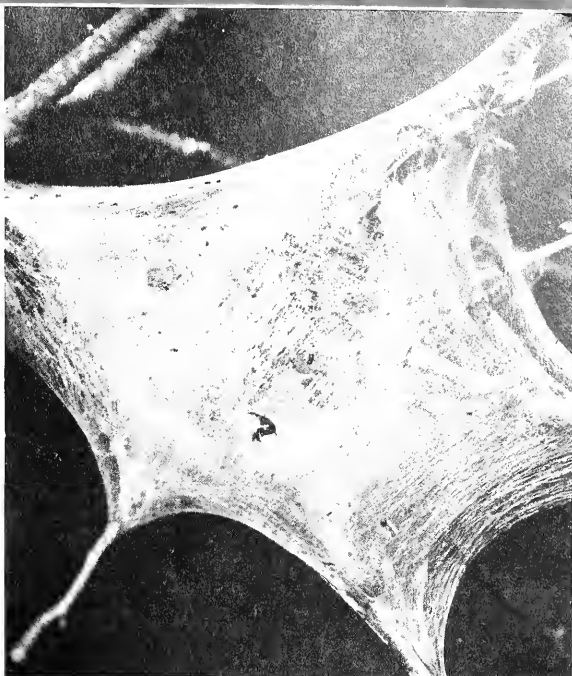
13 . . . the great hordes of caterpillars produced from a single mass of eggs move in and, with terrific appetites, devour all in sight







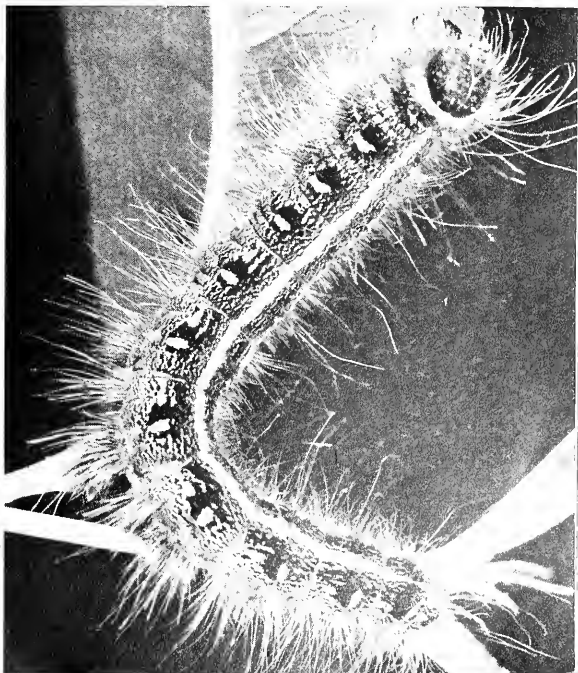
**10** . . . they will soon appear and begin to repair their damaged residence. The silk used in the construction of the tent protects them from the elements and from their enemies



**11** ONLY a few hours are required to repair most of the damage. A few layers of silken thread, and the hole is mended. The repaired area can be detected for days after repairs have been made

**14** AT THE END of an hour, all that is left is the bare skeleton. Almost at once the leaves turn brown and wither, and sometimes large areas of the countryside are blighted by the tent caterpillars

**15** EVEN though you might not like crawling things, you may admire the delicate pastel colors of the full-grown caterpillar. All the colors of the rainbow are found in its varied pattern. But once it is full grown, its crawling, creeping life is ended





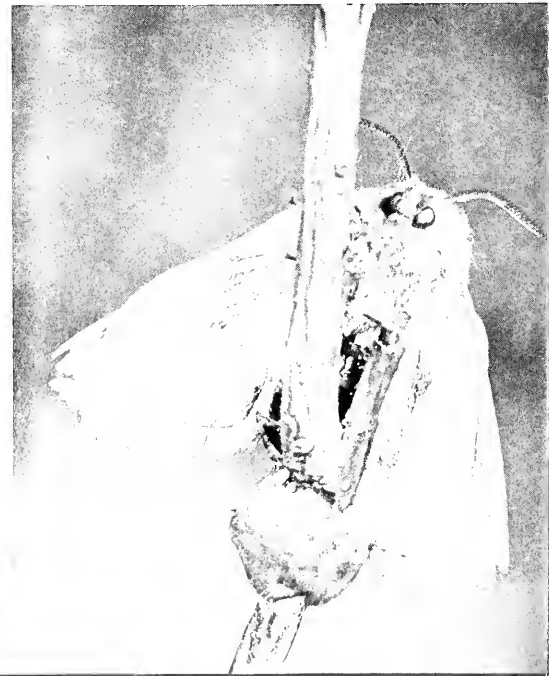
**16** THEN it usually leaves the tree and crawls in search of a protected place in which to construct a cocoon. The silk is white, but a yellowish dust is scattered through it. This flies in all directions when the cocoon is pulled apart

**18** WHEN IT EMERGES from the cocoon, the wings are short thick pads. Blood is pumped into the veins, and the wings slowly expand until they reach full size. Before the moth can fly, it must rest until wings and skeleton harden



**17** CUTTING OPEN the cocoon, you will find that the caterpillar has changed into a pupa. Within the brown cell, the contents rearrange themselves to form all the parts of a perfect moth. When ready to emerge, the front of the cocoon is broken open, and the moth forces its way out

**19** THIS FEMALE MOTH is performing her final function in life. Her wings are battered, and she has lost the freshness and beauty that were hers a few weeks before. But she is laying a mass of eggs from which a fresh, new generation will hatch in the spring







▲ THE SANCTUARY: a tiny pond less than 200 feet long, sitting at the bottom of a deep canyon in the center of San Diego

## THE *Biggest* LITTLE SANCTUARY

How thousands of pintail ducks have escaped persecution in the lap of a busy metropolis

By LEWIS W. WALKER

*All photos by the author*



▲ A BANDED PINTAIL. In a single season, 3000 ducks were banded, and many records were secured indicating the range of the bird's migration

WHEN two dozen pintail ducks were trapped on a lake a few miles from San Diego in 1928, it hardly made a dent on the lake's waterfowl population. At that

time the bag limits were absurdly big, and few people listened to naturalists who complained that normal reproduction was insufficient to keep pace with the slaugh-

ter. Now, 20 years later, the situation has drastically changed. Where there were formerly hundreds of ducks for each hunter, a reverse ratio is now almost true. During

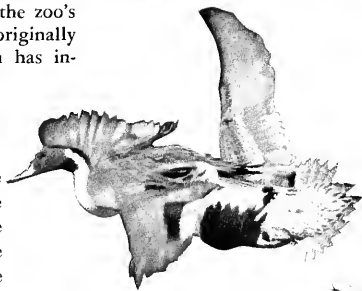


▲ PINTAILS churning the water of the zoo's pond. From the 12 birds which originally tenanted the pond, the population has increased to an estimated 10,000

the hunting season, when these birds fly through an endless barrage from Canada to Mexico, they have found it prudent to forsake the streams and small ponds for the safety of only the largest lakes.

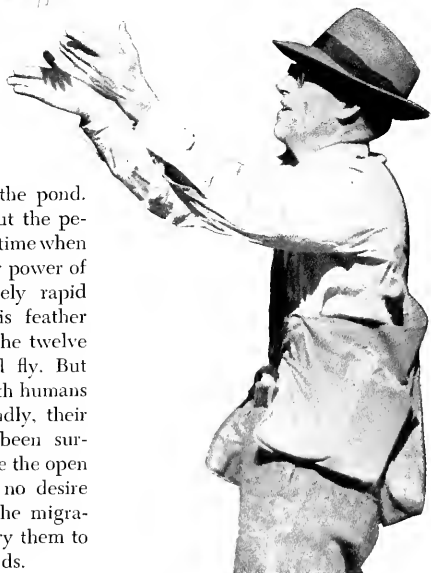
But in retrospect those 24 ducks deserve to go down in ornithological history. While their wild brethren decreased to the present low ebb, the captives formed the nucleus for the San Diego Zoo's biggest little sanctuary. Twelve of the birds were wing clipped and liberated on the shores of a pond that was less than 200 feet long. Aside from a temporary loss of flight, they lived perfectly normal lives. The other dozen were pinioned as permanent captives and after recovering from this slight operation were released to swim with the rest.

When the time for the northward migration rolled by, these two dozen birds remained behind, consorting with semi-domesticated mallards, Canada geese, and other



▼ PINTAIL DUCKS being released after banding. One band was recorded in a wilderness area of Alaska and another in tropical Guatemala—locations near the extremes of the duck's range

waterfowl that lived on the pond. Midsummer brought about the peculiar eclipse plumage—a time when many waterfowl lose their power of flight during an extremely rapid molt. At the end of this feather shedding and regrowth, the twelve wing-clipped birds could fly. But with food aplenty and with humans that were generally friendly, their enforced captivity had been surprisingly pleasant. Despite the open sky above, they showed no desire to leave until they felt the migratory urge that was to carry them to northern breeding grounds.



morning several dozen nervous pintails settled on the zoo pond—the first of the voluntary visits that have brought an estimated 10,000 birds to this tiny body of water!

The population build-up has been gradual during this interval and has approximated what might be expected from the natural increase of the original twelve. The second year 60 to 70 settled on the pond soon after the season opened, and now the waters are solidly blanketed with ducks. An overflow roosts on the hillsides and along the pedes-

trians' walk, where they fight the fence in an attempt to enter the small enclosure.

These crowded conditions have now forced what might be termed an even population, for the pond has reached its saturation point. Many of the pintails bear U. S. Biological Survey bands, which to date have returned two interesting records from spots many thousands of miles apart. One band was recovered from a wilderness area in Alaska, while the other was taken from a bird that flew south to winter in tropical Guatemala. These, of course, represent both ends of the duck's range, but many records of a more local nature have been secured from the 3000 ducks that were banded in a single season.

If you doubt that the ducks know what the sanctuary is worth to them,

drop by around sundown. Each evening immediately after the setting of the sun, which marks the termination of the day's legal shooting, the ducks rise, en masse, form into wedges, and scatter about the county. When encountered on distant lakes, they are wild and distrustful and rarely permit an approach within hunter's range. Dawn brings them once more over the San Diego roof tops and down to the pond, which is practically hidden in eucalyptus trees. This flight not only transports them from one area to another but also seems to alter their outlook on life. Once within the fence they feel safe and unafraid of the thousands of visitors that pass a few feet away. Thus San Diego's pintails outwit persecution in the "biggest little sanctuary" in the world.

▼ DURING the hunting season, the pond is blanketed with ducks. The overflow roosts on the hillsides and along the walks, fighting the fence in an attempt to enter the small enclosure



WHEN Annette Whitney became the wife of naturalist William H. Dall in 1880, she decided quite firmly that a zeal for scientific pursuits was no excuse for interrupting a honeymoon. "Last year," she said to her husband, "John Muir was married only three weeks when he left his bride and went away to Alaska for the entire summer. It's not going to happen to me."

William Healey Dall was filled with the spirit of adventure and had the capacity to turn insignificant events into matters of thrilling moment. He was also practical. He took his wife along on his seventh trip to Alaska.

The little steamer had several awesome escapes while heading northward that shook Mrs. Dall's resolve to be a handmaiden to her husband in all things—even exploring. When the party went ashore at Sitka, the American garrison of troops had been withdrawn as an economy measure. Indians, full of liquor and a determination to right the wrongs of a century of abuse, were marauding the streets, ransacking the Russian Cathedral, knocking down picket fences for firewood, and heaving stones through the windows of scores of buildings left unoccupied in the rapidly decaying town. The beaches were odorous, the region in a state of suspended animation. Every vestige of law had vanished.

A schooner was sailing for Frisco in the morning. At midnight Mrs. Dall shook her husband awake and told him the honeymoon was over. She sailed south with the departing schooner, leaving him to continue into the land that had already brought him fame in the scientific world.

Alaska is such a huge land (one-fifth the size of the entire United States) that seldom has one man become intimately acquainted with all of it—encompassed the length and breadth of it, with its bleak arctic shores, its interminable stretches of muddy Yukon, its fog-blighted islands of the Aleutian chain, and its forest-blanketed "land of the floating mountains," the 1100 islands of southeastern Alaska. Wil-

# William Healey Dall

## ALASKA PIONEER

A modern saga of a man who conquered for science our rich northern territory. A life of hardship and resolute inquiry into the mysteries of a new frontier

By EDWARD A. HERRON

liam Healey Dall is one of those few who made Alaska a part of himself. He took to the land not only with the love that comes easily for any layman who first sees the plethora of mountains, rivers, islands, seas, and tundra but with a scientific zeal, a mental alertness, and an infinite capacity for work, which transferred his love into concrete testimonials written in the annals of science.

Dall was the first American scientist to come upon the virgin Territory of Alaska and to recognize in it a bonanza of new knowledge. Every river that he crossed, every sod of tundra he turned, every remote bay that he dredged brought to light secrets of vanished people and earlier times, of the days when a land-bridge to Asia permitted hordes of gigantic animals to roam the Alaskan pasture lands. And though his first love was for mollusks, he did not confine his energies to that one field but made himself an expert in many.

The information he gathered on the fishes of Alaska was new to the world, as was his list of its mammals, his meteorological observations, his studies of the distribution of plants and animals, and his mapping of the northern limits of tree growth. Young Dall was tireless in his energy and insatiable in his scientific curiosity. He was a latter-

day Columbus alone in a New World.

Dall started life in 1845, four thousand miles from Alaska. He grew up in a Boston family that helped instill in him the seeds to carry on his later explorations. His father was a minister—a soft-eyed, dreamy, poetic soul who sought for peace and harmony in this world. His mother, in contrast, was sharp-tongued, puritanical, practical to the last painful degree, and immensely scornful of poetic dreamings. When escape into books became impossible, the Reverend Dall suddenly developed a missionary fervor and sped away to India where, unfortunately, no accommodations were available for his family.

Poverty was a constant companion in the Dall house—a quiet genteel poverty, not evidenced by tattered clothes but painfully present in the meager meals that came upon the table. With his mother earning extra dollars by writing, teaching, and preaching the virtues of thrift, Dall managed to attend the English High School in Boston, acquiring creditable marks.

It wasn't until he enlisted in 1863 to save the Boston arsenal from a threatened "invasion" that he became aware of the little, crawling creatures of the night. On sentry duty at the arsenal, he went down on his hands and knees, painstaking-



ingly following the slow paths of the snails and slugs that infested the weed-grown patches surrounding the arsenal. He discovered a beautifully illustrated book, Dr. A. A. Gould's *Invertebrates of Massachusetts*. Absent-mindedly he threw away his rifle, greased his boots, and waded along the beaches, seeking the fascinating specimens detailed in Dr. Gould's book. From that time on he felt lost without a pair of spring forceps for collecting the minute forms he could not catch with his fingers.

It was in that period that the sci-

entific passion for shellfish sifted through him. Perhaps some of his father's poetic spirit stirred him as he rejoiced at the delicate nuances of color, the grading into each other of pinks and yellows and soft rose. With boyish enthusiasm he hunted Dr. Gould and told him of new discoveries. Though the Doctor was at first skeptical, he was soon amazed at the boy's powers of perception. Gould arranged for young Dall to attend the Boston Society of Natural History, as a student member paying no fee.

After graduation from high school,

he took a job as office boy with Deshor and Yarrington, African traders on Indian Wharf. He borrowed scientific books and copied them laboriously, word for word, into his notebooks. The rats infesting the wharf grew used to his company, and to them the boy explained that he was forced to copy the books because he surely would never be able to purchase them.

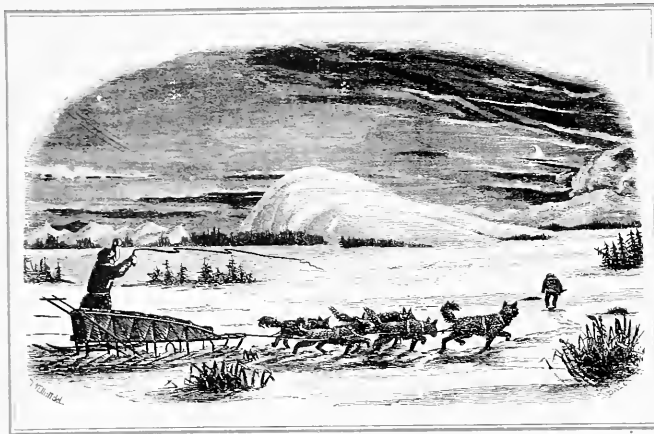
But the spirit of adventure overcame the carping fear of even worse destitution than was his mother's theme song. Impulsively he boarded a train for Chicago—the new, booming town of the Midwest, rip-roaring, wild, full of adventure. There he clerked in the Land Office of the Illinois Central Railroad for \$27.50 a month, but his evenings were spent at the Academy of Science Museum, working on the collections and making the acquaintance of Robert Kennicott.

Dall was feeling the strength of his youth, and his confidence in himself was warding off the fears of insecurity implanted by years of frugal living. He slammed shut the books in the Railroad Office and took off for northern Michigan, searching for iron deposits. When his mother wrote to him, horrified, he told her the new salary, \$54.00 a month, was well worth the risk. The boy was running headlong into the greatest adventure of his life, and if it meant eventual starvation, he was ready for it.

One last temptation stood in his way—the beckoning security of a good job, free from the fluctuations of good times and bad. He was offered the position of superintendent of a lead mine in Missouri at the fabulous sum of \$2,000 a year, but he refused. In the quiet secrecy of his boardinghouse room, young Dall had made a solemn promise to himself never to accept a job that did not permit him to pursue further scientific study.

The Western Union Company's telegraph line across Alaska to Siberia! Dall was offered a job with the scientific party connected with the laying of the telegraph lines across Alaska by Robert Kennicott, director of the expedition. There was a ship south to Nicaragua, then





◀ FROM a sketch by William H. Dall: a scene near Cheerful Mountain (Vesólia Sópka), inland from Bering Sea

a journey across the steaming jungles, and another ship north to San Francisco. Before the expedition had even left San Francisco, Dall sent back 5305 specimens.

He watched Kennicott struggling with the arduous task of assembling ships, crews, and personnel, touching up equipment, fighting delays, worrying nightly because of the prodding telegrams received from the home office over the lack of progress. And he complimented himself on having an obscure place in this huge undertaking, free to probe to their depths the new scientific experiences awaiting him.

The first summer of exploration passed quietly, for out of loyalty to the company and to Kennicott, Dall contributed most of his time to Western Union welfare, holding his scientific fires banked. Even so he was able to bring back another 5160 specimens.

It was on the second journey northward, in the summer of 1866, when he stepped ashore in Saint Michael in Alaska, that a native came running to meet him with a message waving in the air. Bob Kennicott had cracked under the strain of organizing the Trans-Alaska Expedition. Kennicott had been standing by the banks of the Yukon, worn and harried by a thousand gnawing details, when suddenly his heart gave way, and he died.

Dall was unanimously selected as Kennicott's successor. He had just

turned 21. When he wrote to his mother, he told her he was frightened and asked for her prayers.

There was no returning to the States for him that winter. He stood on the beach at Saint Michael, watching the supply ships hurry out of Norton Sound before the ice closed in, then hurried himself up the Yukon to Nulato. When the temperature fell to 40° below zero and all work came to a halt, he took a dog sled and sped down to Unalakleet by the sea, for he wanted to spend the winter where he could watch the ice grinding in high flocs upon the smooth beaches.

He holed up in a small cabin, collecting natural history specimens, letting his zeal for his scientific studies, so long held back by his loyalty to the Western Union Company, fan into new flame. Yet he was lonely, tired, and worried by the possibility of failure.

He suffered through the winter, writing in his journal, "Still can't leave to go up-river. I sometimes think it is lucky the Healeys are a hard-headed race and I have some of the Dall philosophy, or I should go insane or kill myself. Doubtless God has some good reasons for putting me through so hard a mill."

With the first faint signs of spring he wrote, "Feel a good deal better now. Beginning to get a little flesh on my bones, which were nearly bare, for sickness and worry had me down to a skeleton."

With the coming of spring he led an exploring party up the unknown stretches of the Yukon from Saint Michael to Fort Yukon, battling hostile Indians and coping with mosquitoes only a little less deadly. Of the latter, the naturalist Brehm wrote: "Every grass stalk, every twig, every branch, every little leaf sends forth hundreds and thousands of mosquitoes all day long. They rule the land savagely for ten weeks from the beginning of summer until the middle of August. They come in swarms like thick black smoke, surrounding every living creature, filling the air in such numbers that one hardly dares breathe. They transform the strongest man into an irresolute weakling, turn his anger into fear, and change his curses into groans."

On the return downstream, the greatest blow of all awaited. The Atlantic cable had been successfully laid, and the international telegraph line was being abandoned. The expedition was ordered home.

Sitting on the banks of the Yukon, watching its muddy waters swirl by his feet, young Dall nursed his pride and thought of the dismal end of a grandiose scheme. Yet the more he thought of his lost greatness, the lighter were his thoughts, for suddenly he was free again—free to tackle this huge land of scientific mysteries that had been teasing him for two years. He dashed into his tent and composed a letter to the Director of the Smithsonian Institution. He had two hundred dollars coming to him in back wages. Dall proposed that if the Smithsonian would match that sum, he'd devote the entire summer to scientific exploration of the north-land. Four hundred dollars to hire help and canoes, to procure supplies and equipment!

The bargain was made. For its \$200 investment the Smithsonian Institution secured the twenty-four-hours-a-day labors of a man who traveled up and down the Yukon, tramping through the swampy



tundra, digging into the beaches, scaling mountains, fording new streams, his eyes searching every angle of the horizon, his pencil moving endlessly. Over 4500 specimens went back to the Smithsonian.

When Dall returned in quiet triumph to a tower in the Institution, he prepared his book *Alaska and its Resources*, which, though snarled at by the historian Bancroft for its inaccuracies, has withstood 75 years of probing by searchers uncovering the secrets of the northern territory. Along with the book he started the series of short pieces that were to slip out of his pen for the next 57 years.

Dall, in his lifetime, wrote in longhand 1605 articles. Every book he wrote, every pamphlet, every article, every map he drew during the first three decades of American ownership of Alaska was a step from the green-and-white mystery that cloaked the territory into the bright light of scientific knowledge.

The publication of his first book opened a new phase in his life—that of seaman-explorer. Immediately he was appointed Acting Assistant to the Coast and Geodetic Survey and ordered to the Pacific Coast to command the schooner "Humboldt" and make surveys of the Alaskan regions.

He visited all the Alaskan coastal waters, 26,000 miles of rugged, unknown shoreline, and explored the entire Aleutian chain, discovering fourteen new harbors and making extensive studies of the native mummies found on the Islands of the Four Craters and elsewhere. His compilation of the *Pacific Coast Pilot of Alaska* became the foundation of all future Alaskan studies by the Coast Survey.

Yet even on that storm-tossed schooner he was still a scientist, carrying on studies in anthropology, geography, tidal currents, geology, and paleontology.

In 1884, he transferred to the United States Geological Survey as

a paleontologist. He was detailed to work at the United States National Museum, where he served as Honorary Curator of the Division of Mollusks and Tertiary Fossils until his death in 1927.

He received honorary degrees from three universities and was associated with over fifty scientific societies. He traveled to Europe twice to attend conventions, and the learned men of the Continent, before they plunged into the business of invertebrates, first sat like enthralled schoolboys while Dall spoke on "Our Knowledge of Alaska at the Present Time."

After fourteen trips to Alaska, Dall retired more and more to his collection of shellfish. A new generation of scientists grew up about him, and Dall was ready with a word of encouragement.

"The only lesson which may be said to be absolutely clear," he counseled them, "is that naturalists are born, and not made; that the sacred fire cannot be extinguished by poverty nor lighted by a college taper; that the men whose work is now classical owed less to education in a sense than they did to self-denial, energy, a passion for seeking out the truth, and an innate love of nature."

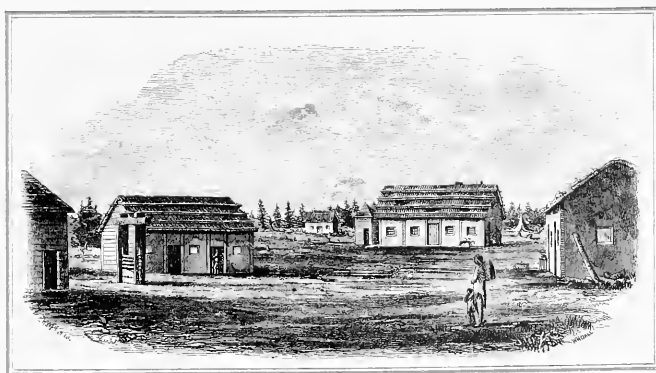
In 1924, when he was nearly 80 years of age, he was retired from government service. But the habit of a lifetime was strong in him, and he continued for three more years to go daily to his tower room in the Smithsonian Institution to study his famous collections. On warm afternoons in Washington's spring

and summer, he wandered to favorite pools and beaches, where he stretched on the rocks to admire the wondrous combinations of form and color in the humble animals crawling in the cracks. He had an intense sympathy for them, and toward them he had a feeling of friendship and a gratitude for a full life.

The leap-frogging porpoise that escorts ships through Alaska's waters is Dall's Porpoise, and the beautiful, white-furred mountain sheep that dares the blizzards of the Talkeetna Mountains in the interior bears the name of the boy who resolved to forego any position that would not give him time for scientific study.

His name is dotted liberally on the maps of the Territory of Alaska. Along with the forty-five-mile-long island in southeastern Alaska, there is Point Dall, which juts into the restless waters of Bering Sea; and below it, in the pock-marked delta between the Yukon and Kuskokwim rivers is Dall Lake, teeming with muskrat, mink, land otter, and weasel. Dall River comes to life high up by the Arctic Circle and drops down to the Yukon where a tiny fishing settlement has taken the name of Dall Village.

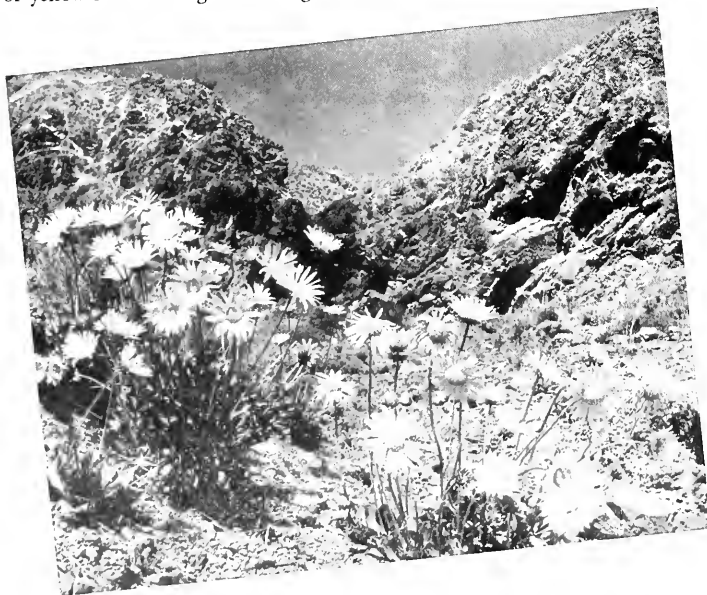
A hundred thousand spectacular, bizarre figures have tramped across the well-lighted Alaskan stage and disappeared forever. It was left for William Healey Dall, the man who ignored the chase for gold while pursuing a love of nature, to stamp his name for all time upon the fabulous land.



► FORT YUKON, on the Arctic Circle, as seen by William H. Dall in 1867, soon after ratification of the purchase of Alaska



▲ THE "CANDLE OF THE LORD" sends up its triumphant banner to tell the desert traveler that spring has come, and the Prickly Pear puts out a silky bloom of yellow in a bursting mood of gladness



# Spring IN THE

By

JOYCE and JOSEF MUENCH

*All photographs by the authors*

COMPARATIVELY few people ever see the desert in spring. The familiar impression is of a landscape eternally stark and barren—a parched world of shimmering dunes and naked mesas. But when spring waves her magic wand over our southwestern states, the deserts come alive almost overnight to remind us, in Donald Culross Peattie's words, that even a savage man can beget gentle daughters.

Plants that complete their growth in a single season are conspicuous among the legions that invade the arid wastes. Of the perennials, only the sturdy and well-armed can withstand the seasons of heat and drought. The total array sometimes surpasses in brilliance and beauty the best that milder climes can offer—not just a lonely blossom here and there but a whole floral extravaganza to waste its sweetness on the desert air.

A faint green plays upon the ground as grasses push up. Tiny flowerets open to spread their pastel shades over the landscape. Presently all the desert plants have

◀ THE BRIGHT YELLOW FLOWERS of the Panamint Daisy (*Enceliopsis grandiflora*) seem to like the dry desert hills of southern California. When spring visits the wastelands, they transform dross into gold

# Rainbow

## DESERT

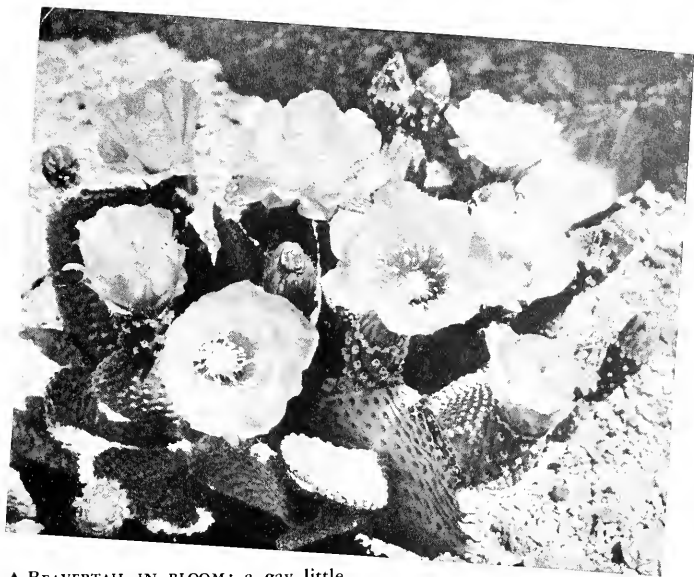
The scorching glare of the desert is supplanted by a brief but brilliant tapestry of colors, when springtime rains swell the sleeping seeds of countless, unexpected flowers

turned green. The cactus seems more vivid; and the smokey Palo Verde trees, the sharp spikes of the Yuccas, and the heavy leaves of the Agave become enlivened with color.

While you watch, the desert puts on its springtime gown. Yellow is a favorite color; it pours out of rocky nooks as the Golden Hills open their cups, and many a sturdy cactus wears a golden crown. The flaming color of the poppies, nodding by the thousands in the wind, seems to set the earth itself afire. Elsewhere, the Desert Aster shows its starry heads of blue, and whole hillsides are shadowed with the Lupines. The quaint Desert Candles of yellow have a purple flame, and every Barrel Cactus wears a wreath of orange. The Beavertails are yellow, orange, or lavender, while the Ocotillo is frankly red, adding its flaming tips to every dry stick that looked dead a week or so ago.

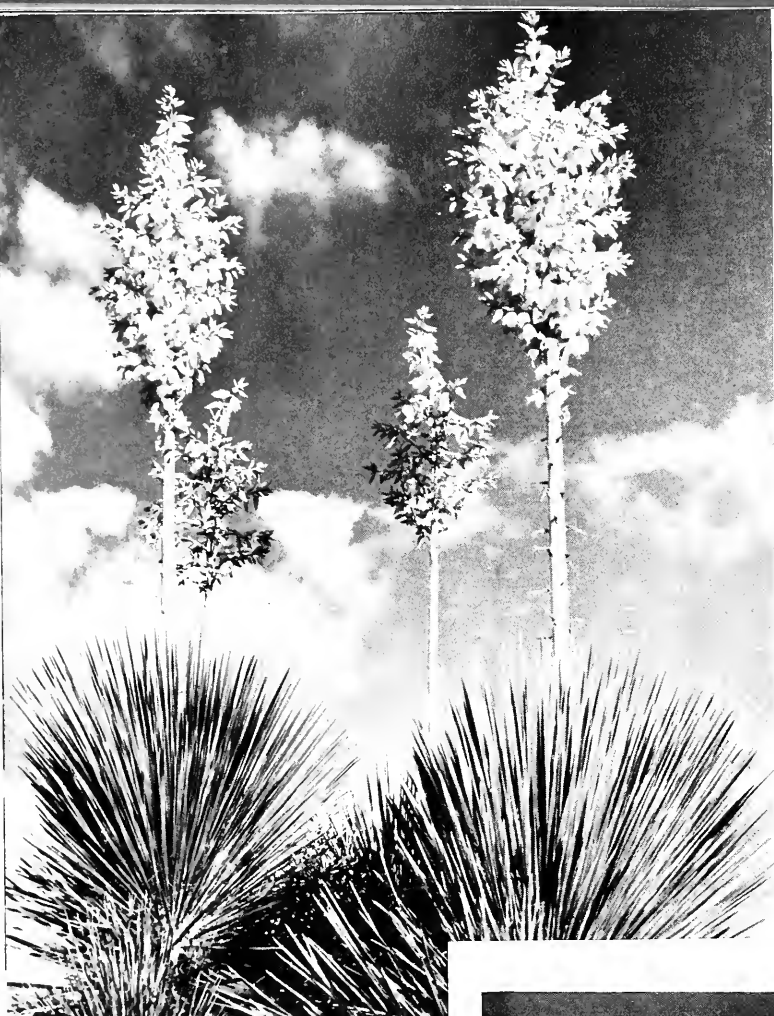
These and a host of other beauties form Spring's Rainbow in the Desert.

► THE DECEPTIVELY fussy-looking Cholla Cactus, with her children gathered about her like animated teddy bears, is another native of the southern Arizona Desert. This is one of the spiniest of all the cactus family



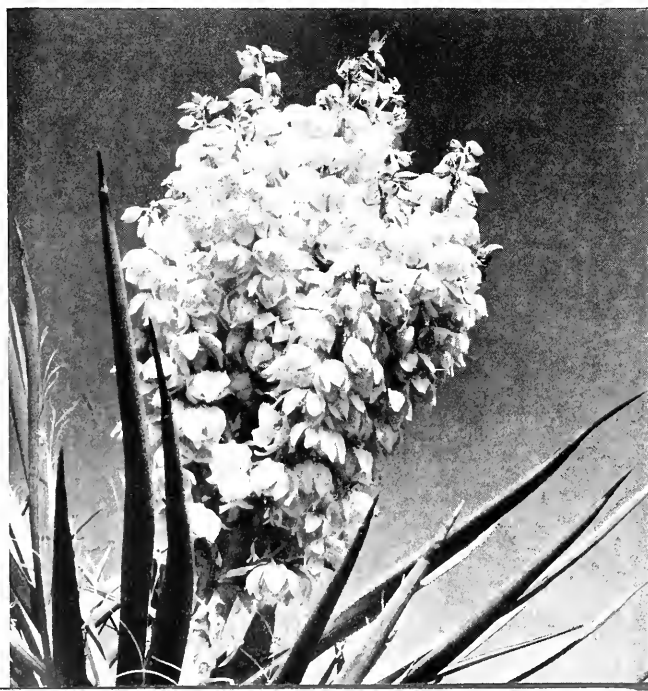
▲ BEAVERTAIL IN BLOOM: a gay little plant that entices you with its massed blossoms of bright lavender-red but punishes the hand that touches it with hundreds of tiny pricklers





▲ **DESERT BANNERS.** The stiff panicles of the Yucca rise out of a rosette of bayonets into the clear desert air

➤ **THE YUCCA** is a member of the lily family that has adapted itself to the rigors of a desert climate. Spring-time brings it to an almost incomparable beauty, with a great panicle of blossoms rising from the uninviting spiked leaves





◀ BENEATH A CLOUD-STREAKED SKY the distant desert hills culminate in Mt. San Geronio, as seen from Key's View in the Joshua National Monument



◀ AGAINST a forbidding landscape, the squat Barrel Cactus looks like a stolid, spiny sentinel until it yields to the season of finery. Then the bristling old Barrel dons a lively crown of lovely flowers, as shown above



◀ PURE WHITE and with a lacy center of yellow and white, this large, amazingly beautiful bloom of the varied cactus family is a generous reward for the effort of a journey into the desert in spring



▼ WEIRD SHAPES stand in silhouette against the clouds of the Arizona sky, where the arms of the Saguaro reach heavenward as though in supplication





ALMOST no one likes venomous snakes on his doorstep, and every spring when people are preparing to move to summer homes the Museum receives scores of inquiries requesting information concerning the best means of ridding their premises of undesirable reptiles. Since it is impossible to know all the details of each person's predicament, it is practical to suggest several ways of eliminating snakes. Among those mentioned below, one or more should be found that can be adapted to fit particular needs.

Snakes, like other animals, have a place in nature. Many of the smaller kinds habitually feed upon earthworms, slugs, crayfish, insects, or spiders, but such predations play an insignificant role in the control of animals that might be regarded as pests. Some of the larger kinds, including copperheads, rattlers, and especially the bull snakes of the middle western prairies, are of importance in rodent control. Nevertheless, there are situations where the destruction of snakes is desirable. The activities of water snakes and garter snakes must be curtailed in fish hatcheries where they prey upon the fry. The U. S. Fish and Wildlife Service found it necessary to devise means of controlling bull snakes in a wildlife refuge where these serpents destroyed more than 40 per cent of the duck nests. And no one questions the desirability of eradicating venomous snakes around human habitations, particularly when children are present.

Few of the possible ways of eliminating or reducing snake populations have been subjected to adequate test to determine their effectiveness. The Fish and Wildlife Service has conducted investigations, as described in their leaflet<sup>1</sup>, and various techniques have been devised by others. Unfortunately, circumstances vary from place to place, and techniques useful under one set of conditions are impractical or impossible to use under others. The following means of

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# The Problem of **SNAKE CONTROL**

How to tell whether the snake at your doorstep is really one of the dangerous ones, and what you can do about it if it is

By C. M. BOGERT

*Chairman and Curator of the Department of  
Reptiles and Amphibians,  
American Museum of Natural History*

---

eliminating snakes have been used or attempted.

**SEARCH FOR AND KILL.** This is the most obvious means and the one most commonly employed. Snakes are secretive animals, however, and there are various reasons for believing that in most areas only a small proportion of the snakes actually present are likely to be seen. When dens, places where snakes aggregate during the winter because of the shelter available, can be located, as they have been for rattlesnakes, copperheads, and some of the nonvenomous serpents, it is often possible to kill them in great numbers when they emerge in the spring. Some ingenious methods of capitalizing on the denning habit of snakes have been devised, as will be noted below.

## **POISONS AND REPELLENTS.**

Because the vast majority of snakes prey only upon live animals, it is ordinarily impractical to use poisoned baits. Bull snakes and chicken snakes are among the few that occasionally enter poultry houses or barns in search of eggs or young birds. According to the Fish and Wildlife Service these serpents have been killed by inducing them to accept eggs in which two or three medium-size crystals of strychnine have been inserted through a small hole, over which a piece of paper has been pasted. Such poisoned baits are likely to become unattractive to snakes unless they are taken

within a few days. Another handicap lies in the fact that these "doctored eggs" are a hazard to poultry, pigs, or to other farm animals that occasionally eat eggs.

Snakes that seek refuge in rodent burrows may be killed by poison gas. Using a long-handled spoon, approximately two ounces of calcium cyanide should be placed well down in the entrance of each burrow suspected of harboring snakes. The opening should be covered with a stone or a piece of sod. If soil is used it may cover the chemical and prevent the escape of the hydrocyanic acid gas that is liberated when the moisture in the air combines with the cyanide to liberate the gas. Fumigation with this gas is effective in destroying snakes in buildings, provided the structures can be tightly closed or sealed for short periods. Severe disadvantages in the use of hydrocyanic acid gas lie in the fact that the chemical is a deadly poison, dangerous to handle and dangerous to use. Unless completely familiar with the precautions that must be taken, one should not use cyanide.

The Fish and Wildlife Service reports that snakes appear to be immune to the effects of phosgene, chlorine, and tear chemicals. Mustard gas, scarcely to be recommended for use around habitations, was successfully pumped into the crevices of a bed of lava where rattlesnakes had sought refuge. The

<sup>1</sup> U. S. Dept. of the Interior, Fish and Wildlife Service, Wildlife Leaflet 257, 10 pp., 1944. Copies may be obtained without charge from the Fish and Wildlife Service, Chicago 54, Illinois.

## VENOMOUS

## HARMLESS



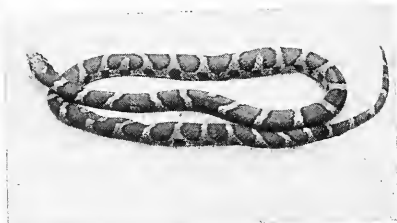
▲ Water Moccasin or "Cottonmouth." The pit between the nostril and eye marks the moccasin as a venomous pit viper. It is not found west of Texas and Kansas or north of southeastern Virginia, along the Atlantic Coast



▲ Common Water Snake. Its pattern may be as dull as that of the moccasin, but it lacks the pit, the fangs, and the sheared-off appearance of the snout in profile. It is widely distributed east of the Rockies



▲ Copperhead. Its dark brown cross bands are narrower at the middle, broader at the sides, and extend onto the belly. Facial pits and tubular fangs identify it as a relative of the moccasin and rattlesnake



▲ Common Milk Snake. This harmless snake is more often seen in the East than the copperhead, with which it is confused. The milk snake has a pattern of brownish blotches margined with black, and a checkered belly

snakes were driven out in a dazed condition and easily killed with clubs. Supposed repellents, including a product called "oil of smoke" offered by one manufacturer, have proved ineffective. The belief long prevalent in the Southwest that a horsehair rope around camp prevents the intrusion of rattlesnakes has been disproved repeatedly, even though it remained for years in the handbook of first aid published by a reputable organization.

**BIOLOGICAL CONTROL.** The introduction of animals to prey on venomous reptiles is of doubtful value and may be hazardous. The mongoose, when introduced into some of the West Indian islands, proved to be a pest that not only entered chicken houses but preyed upon ground-nesting birds and other harmless or beneficial creatures. Hogs have been recommended as snake exterminators, the thick layer of fat beneath the skin

supposedly making them mechanically immune to the effects of venom when they seek to devour a rattlesnake, copperhead, or moccasin. There is no proof that hogs actually eat many venomous snakes. However, when large numbers of swine are present in a small area, their consumption or destruction of the available food and their uprooting of places of concealment may well make the territory uninviting to snakes. Several other mammals, including skunks, weasels, and raccoons, prey upon reptiles, principally upon the harmless lizards, turtles, and snakes. Evidence is lacking that any of these mammals attacks a venomous snake except under exceptional circumstances.

Among birds, some hawks, the roadrunner, and a few others will tackle a venomous snake from time to time, but no bird in the United States is known to feed upon snakes habitually in preference to other foods. In any event, the impracti-

cality of introducing birds and retaining them in the desired region is manifest. The larger domestic fowl (turkeys, geese, ducks, and even chickens) often devour small snakes but rarely attack snakes over a foot and a half in length.

Snakes prey upon other snakes. The larger king snakes in particular are known to be capable of killing and eating small to medium-size rattlesnakes. Large rattlesnakes are rarely if ever eaten by king snakes, and there is evidence that venomous snakes comprise but a small proportion of the king snakes' diet. Extravagant claims made in California that one king snake would kill all rattlers within a radius of a mile are without foundation. It should be borne in mind, however, that the innocuous snakes in any region are competing for food and shelter with the venomous forms. Hence indiscriminate killing is inadvisable. Each nonvenomous snake removed results in a potentially increased food supply to attract the venomous kinds.

**REDUCTION OF THE FOOD SUPPLY.** Snakes are commonly attracted to barns, stables, or storage bins, not only by the shelter afforded but by the rodents that abound where grains are accessible. Poisoning campaigns to reduce rodent populations tend to decrease the food supply of the snakes. But rats and mice are difficult to eliminate, and some of the poisons used in their control are dangerous if used where they may be eaten by stock, poultry, rabbits, pigeons, or other birds. Moreover, snakes such as the copperhead, which feeds on birds, amphibians, insects and their larvae, as well as rodents, might remain on the premises despite the reduction in the mammalian population. Extensive use of DDT conceivably could kill the insects and might either directly or indirectly kill a fair percentage of other animals in the area where it is used. Such "kill-alls" have severe drawbacks, however, inasmuch as they destroy both harmful and beneficial animals.

**TRAPS AND FENCES.** The majority of traps used for other crea-

tures are unsuitable for snakes since they are not easily attracted by baits. Pits can be dug with overhanging sides that serve to retain any snakes that fall in, again with potential danger to humans as well as to livestock. Box traps, similar to fish or lobster traps but not baited, can be made of quarter-inch mesh hardware cloth, with a "funnel" at each end. These have been used with fair success, particularly when they are employed along with "drift fences." Strips of hardware cloth, a foot or more in height and held upright with stakes, can be placed at both sides of the trap and serve to direct the snakes toward the funnel openings. Ralph Inler<sup>2</sup> obtained fair results using such traps to reduce bull snakes in a wildlife refuge, and the trap could be adapted for other species. H. K. Gloyd<sup>3</sup> describes a somewhat similar trap designed by A. M. Jackley for use near Pierre, South Dakota, where an extensive campaign was waged against the prairie rattlesnake. The entrance to Mr. Jackley's snake trap was covered by a transparent flap suspended from hinges on the inside. Snakes could lift the flap as they crawled into the cage; then they descended to the bottom on a chute, and since the flap swung only one way, they were unable to crawl out. Dens where rattlesnakes aggregate in fair numbers often have several entrances. By closing all openings except one and directing the snakes into this trap with a section of pipe, or chute, thousands of rattlers have been captured.

At times Mr. Jackley has found it necessary to surround the area of the den with a screen wire fence. Even without a fence many of the rattlers could be killed by hand as they emerged from the den. Fences have also been used around houses or other enclosures to keep out snakes. For this purpose a strip of quarter-inch mesh hardware cloth a yard or more in width can be used, set in the ground to a depth of about six inches. Tightly fitting gates must be kept closed, and the

fence must be constantly inspected to be sure that rabbits or other animals do not succeed in burrowing under it.

**REMOVAL OF SHELTER.** All snakes, as well as the animals that they eat, require places of concealment to avoid their enemies and to escape the effects of continued sunlight. Under some conditions it is possible to remove all rocks, boards, or other debris beneath which snakes can hide. Burrows may be filled and rock crevices closed with concrete. All underbrush, weeds, shrubbery, and any trees with holes at the base should be removed. In many areas the removal of shelter is probably the simplest method of discouraging the presence of snakes, although if adjacent areas are not similarly treated, a few snakes inevitably wander into the cleared area. Where rock walls exist, the

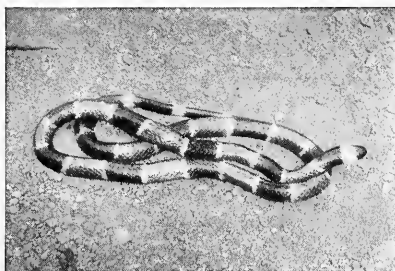
difficulties are great, and the "snake-proofing" of old barns, stables, or other buildings is not an easy matter.

**LARGE-SCALE CAMPAIGNS OF ERADICATION** never should be attempted without the advice of a competent naturalist. It is desirable to make preliminary investigations to determine whether the supposed menace actually exists. Harmless snakes, particularly the common hog-nosed snake, the milk snake, and the bull snake, are often mistaken for copperheads and even for rattlesnakes, despite the availability of some excellent handbooks for their identification<sup>4</sup>. During the last ten years nearly a hundred snakes have been brought to the American Museum by individuals who were certain that they had killed a venomous snake. Of this number only three were venomous,

#### VENOMOUS



▲ Timber Rattlesnake, one of 26 kinds in the United States. Other snakes vibrate their tails, but only the rattlesnakes have rattles (at birth a bell-shaped "button"). None reported recently in Maine, Delaware, or Long Island



▲ Eastern Coral Snakes. Venomous relatives of the cobra, coral snakes in the United States have the red bands bordered by yellow, in contrast to the false coral (king) snakes, which have the red bordered by black

#### HARMLESS



▲ Hog-nosed Snake. The hog-nosed snake is harmless despite its ferocious antics and such vernacular names as "puff adder." Its loud hiss and stocky body presumably cause it to be mistaken for the rattlesnake



▲ The Mountain King Snake of the Pacific Coast has the black snout of the true coral snake, but its red bands are bordered by black as in other harmless ones. The false coral snake of the Southeast also has a red snout

<sup>2</sup> *Journal of Wildlife Management*, vol. 9, pp. 265-273, 1945.

<sup>3</sup> *The Chicago Naturalist*, vol. 7, pp. 87-97, 1945.

<sup>4</sup> One of the best is *The Handbook of Snakes*, by Schmidt and Davis, which can be procured through The Museum Bookshop at \$3.75 a copy.

two of them copperheads, one a rattler. Frequently the discovery of a single snake leads to the hasty assumption that the region abounds with rattlesnakes or copperheads. Subsequent investigation usually proves the belief to be groundless. The occurrence of snakes is seasonal. Usually they are most active in spring, and there are occasional years when one kind or another is encountered in extraordinary local abundance. But in the United States scarcely five persons in a million are likely to be bitten by a venomous snake in the course of a year.

By and large, the worries of summer residents concerning snakes are far out of proportion to the dangers that potentially exist. Where the presence of venomous snakes in considerable numbers can be confirmed, a suction type snake bite kit, such as that supplied by Becton, Dickinson and Company under the name "B-D Asepto Snake Bite Outfit," should be on hand. The directions for its use should be read in advance even though there is no real likelihood that the device will ever be used. Fatalities from common accidents in the home greatly exceed those from venomous snakes in the United States. With ordinary precautions—and in some places the wearing of shoes, boots, full-length trousers, or even leggings is advisable—the danger from venomous snakes is exceedingly small.

The snake's role in nature is that of a predator on small animals. Principally to enable them to subdue their prey, venomous snakes are equipped with fangs. These tubular teeth are used for defense when these snakes are molested or attacked. Rattlesnakes, copperheads, moccasins, or coral snakes are not to be feared so much as they are to be respected—as animals able to defend themselves and, in many instances, as potential destroyers of destructive disease-bearing rodents. Nevertheless, no one wants a venomous snake at his doorstep. By employing one or more of the methods suggested, snakes can be virtually eliminated when they become a nuisance or a hazard.

# Yes, it's an Orchid

In contrast to the five-inch queens of the orchid family, this ugly duckling is less than two-fifths of an inch across and has an offensive odor


By ALEX D. HAWKES

THIS tiny orchid is one of a hundred or more plants known as "Frog Orchids." Though one sees nothing particularly batrachian about it, it certainly does have a bizarre and unusual appearance, almost more like an animal than a plant.

Even on a quiet day, these little flowers are noticeable because of the almost perpetual movement of the labellum, or lip.

This tiny part, which may be seen in the photograph as a vaguely triangular section with a recurved tip, is greenish-white and brown-red in color. It is mounted on a very slender flange which permits it to vibrate up and down with the passage of every slight breath of air.

The Frog Orchids belong to the genus *Bulbophyllum*, which is one of the largest aggregations of species of orchids. It embraces a motley crew of an estimated 1200 different kinds, which are distributed throughout tropical regions of the earth, with a large number of highly specialized types in Africa. This one is found in a large part of western Africa, where it grows mostly on trees as an air plant.



▲ THE DELICATE LIP, or labellum, curving down like a tiny tongue, vibrates up and down continually even on a quiet day, so lightly is it hinged to the rest of the flower

The myriad species of the Orchidaceae, or orchid family, are extensively disseminated over the globe from the Arctic regions to Patagonia and South Africa. They are particularly numerous in the tropics, with distributional centers occurring in such diverse regions as Colombia, Brazil, and New Guinea.

The continent of Africa is often pictured by the fanciful as a great dark land of jungled mountains, in which every tree is hung with ponderous pythons or festooned with flamboyant orchids. In reality,

Photo by  
Jack Brant

by botanists, has been known since 1826, when a great English student of the orchid family, John Lindley, first described it. For many years it was a favorite in British collections, but it is little known on this side of the Atlantic and is rarely encountered in our greenhouses.

The photograph well shows the arrangement of the flowers, which are only about four millimeters across and thus not especially suited for milady's corsage. Their coloring is rather unusual, being mostly brownish-red and pale apple-green, though there is an erect orange-yellow sepal, which may be seen prominently in the photograph.

These wee blossoms are produced from a flattened portion of the flower spike, which is known as a rachis. In this group of *Bulbophyllum*, the rachis is often of considerable size and is frequently more conspicuous than the flowers themselves. In our present species it is about half an inch wide and only a couple of millimeters thick. It is of a lurid purple hue, mottled with darker red-purple, and provides an interesting base for the little widely-gaping blossoms.

Many *Bulbophyllum*s are furnished with a scent of varying degrees of pleasantness or fetidness, and our little Frog Orchid is blessed with a faint odor resembling dirty feet. We are fortunate that it does not bear the foul smell of its relative, *B. beccarii*, a prodigious species from Borneo, which is said to suggest a herd of dead elephants!

This weird plant is almost the exact antithesis of the great vulgar *Cattleyas*, utilized so commonly as decorations by the female of our species. Few similarities are evident between these elfin blossoms and the grandiose frills of the purple or white orchids that we see in florists' showcases, but both are truly members of the orchid family. Its more than 20,000 species allow ample room for variation and diversity in form, but comparing our *Bulbophyllum* with a lush *Cattleya*, who would say they were both orchids? Close inspection of the structure of the flowers, however, reveals the truth, and we see at last that "Yes, it's an orchid!"

it is a remarkably sparse collecting area for these exotic plants. To be sure, there are numerous orchids in Africa, many of which are showy and spectacular, but in comparison with other great tropical land masses, Africa is poor orchid country indeed.

*Bulbophyllum falcatum*, as this intriguing little plant is designated

YES, IT'S AN ORCHID



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## WE GO GOOEYDUCKING

Continued from page 167

be dug was human hands or a shovel, often referred to as a "clam gun." Henceforth, it would not only be poor sportsmanship but also illegal to jab a fishhook into the bivalve's projecting part and let the wounded animal draw down with it into the mud a cord or stick for the geoducker to follow in his digging.

This legislative interest in the geoduck may have an even earlier beginning if one is to believe an account given in the *Tacoma Daily Ledger* for July 27, 1917. A correspondent in Tacoma wrote in at that time to enter a controversy over the origin of the word geoduck. According to Carroll A. Gordon, the aboriginals of the Puget Sound area knew the clam as "hyas squish-squish," and their name for it has not been perpetuated. On the contrary, the first white man to recognize the animal was a John F. Govey, who later became mayor of Olympia, a member of the constitutional convention, and later of the state legislature. It seems that Mr. Govey was an ardent duck hunter, but on some occasions he found no targets for his gun. On one of these expeditions along the coast, he let his bored attention wander to the near-by ocean's edge. It was a minus tide, and he noticed the water jets emitted by the clams. He got no ducks on this trip, but he brought home a number of the squish-squish. He displayed them as the results of his duck hunting trip, and the bivalves came to be known as Govey's Ducks, later shortened to goeeyducks. If Carroll's tale is to be believed, Govey and his giant clams influenced the selection of the state capital. Olympia was close to large supplies of the squish-squish, which would provide an annual supply of excellent food for legislative suppers!

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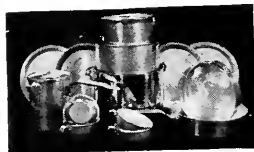
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Appealing as this yarn is, the word may be a misspelling of the Nisqually-Puyallup Indian name for the big clam, "gwe-duc." And although Carroll Gordon's letter denies vigorously that this word is a part of the Indian vocabulary, a resolution drawn up by the Indian Convention, in 1914, was printed in full in the *Tacoma Daily Ledger* (May 2, 1915).

*Panope* is the name of a sea nymph in classical mythology. The word was applied first to a relative of the geoduck found, in 1806, in the Mediterranean Sea and off the coasts of Spain. Others of the same group have been located in deeper waters near Alaska, Florida, and around Patagonia, as well as in Australia and New Zealand in the Southern Hemisphere, and as fossils in the United States, Europe, and India. All seem to be creatures of the ooze beyond low tide mark. Some have been caught accidentally by a hooked line dragging along the bottom at 90 fathoms. The hook snagged a *Panope* neck and pulled the giant clam from the soft ooze. We're not going down that far to look for goeeyducks.



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earlier book is a most readable story of botany, illustrated with superb photographs, many in full color. With his literary ability, the author combines expert skill as a photographer, a skill so excellent as to be the despair of most photographers who are interested in the nature field.

In the book now under consideration, Mr. Platt has carried still further his outstanding ability with a skill fully equal to that of his first book. He discusses more of the philosophy of botany and some of the closely related subjects, in a way that will be most welcome to the nature lover.

To criticize adversely a beautiful volume such as this is hardly justifiable, but this reviewer believes that the technical scientist will rarely be found who will give as much credence to Wegener's hypothesis of continent-drifting as is given by our author, even though supported by the plausible evidence of "Gondwanaland."

The monkey puzzle tree is not the Norfolk Island Pine but another of the genus. The California Big Tree is not as tall as the Coast Redwood. It is perhaps best to say that reptiles and birds have common ancestors, but these are not important criticisms.

Like his first book, which a few years ago earned for the author the Burroughs Award, this is more than a catalogue with names and photographs of plants. It is a story to be read, written by a man who discovered his interest in nature after he had matured and had engaged in the business world. It is evident how much Mr. Platt has added to his own real joy, as well as to that of a multitude of readers, in putting it in the form of this charming book!

CLYDE FISHER.

## THROW ME A BONE

----- by Eleanor Lothrop

Whittlesey House, \$3.00  
234 pp., 22 illu.

ARCHAEOLOGY with its hair down and its glamorous make-up stripped off is the subject of this hilarious, behind-the-scenes book. And Eleanor Lothrop should know. Not only did she marry a prominent archaeologist; she accompanied him on expeditions to the backwoods of several Latin American republics. Mrs. Lothrop is not concerned primarily with scientific discoveries, and indeed, her frequently irreverent remarks may shock the academician. They cannot, however, fail to entertain the layman who is interested in knowing what goes on and how the scientists live on an archaeological expedition.

The book is divided into three sections, dealing with her experiences in Chile, Guatemala, and Panama, and is illustrated with amusing drawings by John O'Hara



## Do You Have Their Number?

By EDWARD DEMBITZ

Here's a chance to use some of that miscellaneous information about animals you've accumulated. The problem in this quiz is to select, from the three possibilities listed for each statement, the number that is most nearly correct.

1. The distance a Skunk can propel its protective fluid is 4 ft. 10 ft. 25 ft.
2. A good hop for a startled adult Gray Kangaroo would be 25 ft. 45 ft. 10 ft.
3. In one hour a continuously moving Snail will travel 1 ft. 10 ft. 80 ft.
4. At birth an American Black Bear weighs 80 lbs. 10 lbs. 1 lb.
5. Greyhounds over a quarter-mile course have averaged 36 m.p.h. 15 m.p.h. 60 m.p.h.
6. The pairs of legs per House Centipede number 50 15 3
7. The longest King Cobra ever captured measured 42 ft. 31 ft. 18 ft.
8. An average jump for a Bullfrog on land is about 5 ft. 12 ft. 25 ft.
9. The biggest Lake Trout taken with rod and reel weighed 27 lbs. 63 lbs. 49 lbs.
10. Maximum length of an Elephant's tusk is about 4 ft. 11 ft. 15 ft.
11. The height of an average adult Giraffe is 26 ft. 12 ft. 16 ft.
12. A Human Flea can jump, horizontally, about 1 ft. 3 ft. 10 ft.
13. The gestation period of an Elephant is 9 mos. 20 mos. 48 mos.
14. Maximum distance a six-foot Rattlesnake usually strikes is 1 ft. 4 ft. 6 ft.
15. The number of litters per year for a Cotton-tail Rabbit is about 4 12 36

Turn to page 192 for the correct answers

Cosgrave, II. The strange places described in Mrs. Lothrop's narrative are peopled by equally strange characters, including dour Brother Claude who later

eloped with a young French girl, a Zutugil Indian nicknamed—not inappropriately—Pretty Boy Floyd, and a New York playboy, Andy, fresh from the playing fields of El Morocco and "21."

The high point in the book is the account of the expedition to the fabulous site of Coclé in Panama, one of the most spectacular digs in the New World. If the returns of archaeological excavation are occasionally dull, those at Coclé resemble a highly successful treasure hunt.

Mrs. Lothrop corrects many popular misconceptions regarding the life of the scientist in the wilds; living near to nature may have romantic moments, but she makes out an excellent case for running water and enamel fixtures. In the end, however, after a series of spirited skirmishes with assorted insects, snakes, scorpions, (and an English Colonel), the author returns to the United States only to discover that the discomforts were really not so bad and that she genuinely misses the excitement offered by life in remote places. HARRY TSCHOPIK, JR.



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## FREDERIC REMINGTON. ARTIST OF THE OLD WEST

- - - - by Harold McCracken

J. B. Lippincott Co., \$10.00  
157 pp., 80 illusts.

**H**AROLD McCracken, the author, is a well-known explorer, writer, and long-time collector of Remingtoniana. The introduction was written by James Chillman, Junior Director, Museum of Fine Arts of Houston, Texas. The book is dedicated to the artist's sister-in-law, Emma L. Caten, who, as pointed out by Mr. McCracken, has done more than any one else to keep alive the memory of Frederic Remington.

In a recent delightful review of this

book, Thomas Craven, the critic and interpreter of art, reminds his readers that when he was a boy in the cattle country of the West, the name of Frederic Remington was a household word throughout America—that three times out of four, a cover or a double-page spread in full color by Remington would appear in *Collier's*.

After Remington had achieved such great popularity, he probably gave us a glimpse of his secret when he said, "I paint for boys from ten to seventy."

Of special interest is the drawing of "The Charge of the Rough Riders at San Juan Hill," which was used by Theodore Roosevelt in his series of articles on "The Rough Riders." It is believed that this painting eventually helped fur-

ther Colonel Roosevelt's political career. All of Remington's work is striking, but special mention may be made of one that is rather generally considered his most popular, namely, an oil (Plate 18) titled "Evening on a Canadian Lake."

A bibliographic check list of Remingtoniana has entailed an immense amount of work on the part of the biographer. This list of 32 pages includes 2739 drawings and paintings, not to mention bronzes, books, etc.

As his epitaph he selected, "He knew the horse," and to this can be appropriately added, "He knew the Cowboy, the Indian, the Frontiersman, and all else that went to make up the Old West, as no other artist has ever known them."

CLYDE FISHER.

## LETTERS

*Continued from page 146*

ready protected in some park. Letters or discussions urging protection of this area should therefore define it as the tract north of the South Calaveras Grove—not just the Sequoia area itself, which contains enough Sugar Pines to permit ambiguity. The additional cost of saving these finest Sugar Pines remaining in our country would be small compared with the disgrace of allowing their destruction.—Ed.

### Coastal Surveys Exhibit

A new exhibit demonstrating the work and recent progress made by the United States Coast and Geodetic Survey was placed on display recently at the Hayden Planetarium. Highlighting the nine-panel display is a plastic relief model of north-eastern United States showing the relationship of land and submarine topography. A model of the Hudson River Canyon shows the vast submarine canyon

of the Hudson River, which has often been compared with the spectacular "above water" canyons of the world. Charts show the configuration of the ocean bottom and the location of the Hudson River Canyon and other smaller canyons along the edge of the Continental Shelf.

Another panel illustrates the performance of the Coast and Geodetic Survey Nine Lens Camera, which is used for aerial survey work. On a single piece of film 23 inches square, the camera takes nine photographs simultaneously, which can be fitted together to form a comprehensive aerial photograph of the area covered. The exhibit also includes photographs showing the effect of electronic developments on nautical chart construction and various other modern aspects of this work, as well as reproductions from copperplate engravings of early surveys.

The exhibit, under the auspices of the United States Department of Commerce, will be on public display until May 15

on the first floor of the Hayden Planetarium, New York City.

### Indian Populations

SIRS:

In your February issue you commented on the Indian population, stating that, due partly to the growth of the Navajo tribes, there are now more Indians in this country than there were when Columbus discovered America in 1492.

I have seen this statement somewhere else—just where, I can't remember—so know it to be correct. Would you mind giving me the source of this data . . .

CARTER H. HARRISON, JR.

Chicago, Ill.

The earliest reasonably reliable estimate of the Indian population in the United States is for 1861, when the total was 249,707, or about 76% of the number in 1940. In 1900, the population was about 72% of its present size. Prior to 1861, estimates must be based largely on the impressions of travelers. The figures can therefore hardly be accepted at face value. As to whether the original Indian population was larger than it is now, one can find divergent opinions. Some estimates total as high as two or three million. A more reliable study of the data by the distinguished anthropologist A. L. Kroeber would place the figure somewhat under 750,000, excluding the Indians north of the Canadian border.—Ed.



## AUTHENTIC DINOSAUR TRACKS

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### Answers to quiz on page 191

(A score of eight or ten is about average)

- |               |                |
|---------------|----------------|
| 1. 10 ft.     | 10. 11 ft.     |
| 2. 25 ft.     | 11. 16 ft.     |
| 3. 10 ft.     | 12. record.    |
| 4. 1 lb.      | 18 ft., 7 in.) |
| (more exactly | 12. 1 ft.      |
| 13 oz.)       |                |
| 5. 36 m.p.h.  | 13. 20 mos.    |
| 6. 15 prs.    | (actually,     |
| 7. 18 ft.     | 18-23 mos.)    |
| 8. 5 ft.      | 14. 4 ft.      |
| 9. 63 lbs.    | 15. 4 liters   |



*May*

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1948

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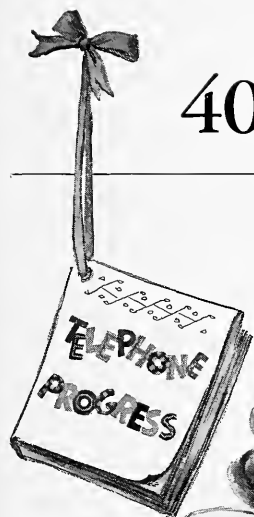
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Photo by Willard G. Van Name

## The SUGAR PINES of Beaver Creek Valley

In the February issue of *NATURAL HISTORY*, we published an article on the need of action if the Sugar Pines of Beaver Creek Valley in California are to be saved from destruction for commercial use. These trees, which reach a diameter of more than 8 feet and a height of from 200 to 240 feet, are the most magnificent pines in the world. The logging railroad is eating its way toward them and has almost reached its objective.

Dr. Van Name emphasized in this article the danger of continued ignorance regarding this unique natural wonderland of Beaver Creek Valley and called for the free spread of information concerning it. Commercial interests have not chosen such a course. Hence, if both sides of this democratic issue are to be heard, it remains for others to ensure a fair hearing without delay.

A measure of the urgency and size of the task can be gotten from a brief review of the effort. Around 1941, the Emer-

gency Conservation Committee became interested in the preservation of this region and vigorously pressed the cause for six years. In 1942, the Emergency Conservation Committee sent Mr. Fred M. Packard to make a survey of Beaver Creek Valley and adjoining areas. Readers will recall the letter from Mr. Packard (now Field Secretary of the National Parks Association) in *NATURAL HISTORY* last month, reaffirming his endorsement of the project as one that every conservation club and society should energetically support, and referring to the results of his survey.

Some may have doubted Dr. Van Name's accusations as to the extent to which some of those opposed to preservation of this territory have contrived to confuse or conceal the issue. We re-emphasize the seriousness of this opposition.

Mrs. Charles Noel Edge, Chairman of the Emergency Conservation Committee, writes, "It is important to note that it has been the commercial and political influences that have worked to prevent saving the forest, and their opposition has most often been expressed in bland and misleading terms. On the other hand, various chambers of commerce and conservation groups have endorsed the plan. Editors with whom Mr. Packard made contact in California were personally interested, and newspaper comment was entirely favorable. Editorials were published in at least five California papers." Mrs. Edge further states, "A project concerning which few make open opposition is stalled. The ques-

tion then remains: Must we conservationists again, as so often in the past, stand by while commercial and political interests combine to silence federal, state, and private organizations that should be battling to avert sacrifice of this world wonder?"

We mention all this not only to give credit to the valiant efforts of the Emergency Conservation Committee in what has often seemed a hopeless cause but to point out the strength of the commercial opposition. If the public does not wish to save the Sugar Pines of Beaver Creek Valley, or is unwilling to exert itself in this direction, that is one thing. If, however, they do not know about this remarkable forest or are confused as to which area is meant, that is another.

In direct response to Dr. Van Name's article, a number of readers of *NATURAL HISTORY* wrote to Governor Earl Warren of California urging preservation of these Sugar Pines. It will be recalled that Dr.

Van Name sharply distinguished this area from the South Calaveras Grove of Sequoias to the south of it. He even included a map showing clearly the location of the Sugar Pines of Beaver Creek Valley. Some may have thought that he was laboring the point when he gave specific directions to designate the area as distinct from the South Calaveras Grove.

We feel it necessary to publish the answer these correspondents received in reply to their letters, for it has caused confusion. So far as we know, all of our readers who expressed themselves in behalf of this cause received the following mimeographed letter from A. E. Henning, Chief of the Division of Beaches and Parks, State of California. Since a number of persons whose names we do not know probably received this letter, and since those who troubled to forward it to us readily concluded that we had taken issue on this question without being fully informed, we are publishing the letter below. The words enclosed in brackets are our own comments:

Dear Mr. ....:

This is in reply to the letter which you addressed to the Honorable Earl Warren, Governor of California, relative to the saving of the South Grove of the Calaveras Big Trees [*not the area we were talking about*], same having been referred to me for reply.

First of all, may I advise that we have a definite promise from the Pickering Lumber Company that they are not scheduled to start cutting operations in this grove [*not the grove we are talking about*] on April 1, 1948.

Secondly, that the State of California, through the State Park Commission, made available \$500,000 toward the acquisition of this grove [*not the grove we are talking about*] more than a year and a half ago. This money is still available, but cannot be expended until a like sum has been donated from other sources for matching purposes.

If you desire to assist in the saving of this splendid grove [*an altogether worthy cause but not the area we are talking about*], you may make your donation to the Save-the-Redwoods League, 114 Sansome Street, San Francisco, California.

I am also enclosing a mimeographed memoranda setting forth the present status of this proposed acquisition.

Sincerely yours,

A. E. HENNING, Chief  
Division of Beaches and Parks.

Division of Beaches and Parks,  
State of California,  
Sacramento, Calif.

So far as we can gauge, none of those who received this letter realized that the statements contained in it did not apply to the Sugar Pines of Beaver Creek Valley. Meanwhile the plan to cut the trees continues.

—Ed.



# NATURAL HISTORY

*The Magazine of the American Museum of Natural History*

FREDERICK TRUBEE DAVISON, President

ALBERT E. PARR, Director

VOLUME LVII—No. 5

MAY, 1948

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## THE COVER THIS MONTH

### MARSH MARIGOLD

One of the cheeriest of the early spring flowers to appear in the swamplands of boreal America is the Marsh Marigold, or "Cowslip" (*Caltha palustris*). Their large, bright blossoms often carpet the wet meadowlands with yellow, giving advance notice of their buttercup cousins who will follow as the spring flowering period advances.

The Marsh Marigold is a member of the large Crowfoot family (Ranunculaceae), which includes, besides the common buttercups, such familiar herbaceous species as hepaticas and anemones, columbines and delphiniums, and the like.

Many members of this assemblage have acrid narcotic poisons of one type or another in their stems and leaves. Fresh plants of the Marsh Marigold contain a poisonous principle, *helleborin*, which curiously enough can be removed by thorough boiling. In fact, the succulent growth of young Cowslips has long been a popular spring green or potherb in New England. And in other parts of its range, particularly in the Southeast, the flower buds, soaked in salt water and then cooked in spiced vinegar, are made into a popular pickle that is very similar to capers.

WALTER HENRICKS HODGE.

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Elizabeth Downes, Editorial Assistant.  
Atherlie E. Karp, Editorial Assistant.

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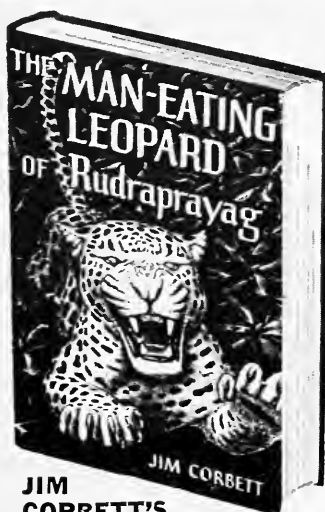
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### OUR PLUNDERED PLANET

----- by Fairfield Osborn

Little, Brown & Co., \$2.50  
217 pp.

AN urgent cause needs two kinds of champions. The first is the student and fact-finder whose work endows the problem with significance. The other is the wielder of the torch, the blower of the clarion, the educator who tells (and convinces) the "man in the street."

The author of *Our Plundered Planet* belongs in the second category. He states that the value of his text "will be derived not from special knowledges but from the perspective that may come from the lack of them." The important thing to be said about his book is that it is likely to reach many thousands of readers who were not already familiar with the gist of its message.

The plan of the book is original and its development enthusiastic and unabashed. Mr. Osborn has spared no pains to have his factual data checked by the foremost authorities in pertinent fields of science. He has not stopped there, however, for he makes the best use of the equally important emotional and spiritual aspects of the situation. Soberly, yet dramatically, he tells how man, and more particularly "civilized" man, has overspent the interest and dug deeply into the capital of natural resources. Effects of the cash crop motive in human activities are hung up in the light for all to see. Our species, the lord of creation, has been increasingly busy flouting the principle that "a resource is economically ripe when its use will support its own conservation."

In the history of the earth, man has been until recently a sparse and minor animal. He began as what Professor Harlow Shapley has called a slight protoplasmic smear on a lesser planet. But he has succeeded biologically—too well—until he has become a large-scale, primarily destructive, geologic force. To make matters worse, he is now adding 17,000,000 annually to his numbers, even though about two-thirds of the individuals in his

total population are undernourished all the time.

Small wonder that an Oriental statesman can say, "Our last famine was a failure; it killed only 3,000,000 people!"

R. C. M.

### SEXUAL BEHAVIOR IN THE HUMAN MALE

----- by Alfred C. Kinsey,  
Wardell B. Pomeroy, and  
Clyde E. Martin

W. B. Saunders Co., Philadelphia and  
London, \$6.50

TEN years ago Alfred C. Kinsey, Professor of Zoology at the University of Indiana and an entomologist of distinction, began a survey of American sexual behavior patterns, collecting detailed records of the sexual life of whatever human subjects he could persuade to co-operate with him in this enterprise. He had become deeply impressed by the lack of reliable, objective information on this subject which, although universally admitted to be a fundamental aspect of human life, was nevertheless shrouded in mystery and hedged in by social taboos. Moreover, he very soon realized that if the data he was collecting were to be useful for more than a very limited segment of the population, his studies had to be based upon an adequate sampling. He has calculated that his case histories will eventually run to 100,000. Up to now, he and his associates have accumulated about 12,000, of which 5300, on white American males, constitute the basis of the present study, already widely known as the "Kinsey Report." This is the initial volume in a projected series of studies.

The magnitude of Kinsey's undertaking is breath-taking. It demands a stupendous amount of energy, a rare persistence, and a degree of dedication rarely encountered. But above all, it calls for a special skill in acquiring kinds of information that are not readily available or easily transmitted.

I shall not attempt to summarize here the results of this investigation. Even if space were adequate for such a task, the mass of detail involved would stagger a more ambitious pen than mine. It may suffice to say that I cannot think of any facet of overt and very few of any other kind of sexual behavior that are omitted. If certain premises to the study are accepted or supported by the evidence,

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then Kinsey's statistical summations must be regarded as the closest approximations we now possess of the patterns of sexual behavior of American males.

Essentially there are three major premises underlying the final tabulations that require close scrutiny. Is the sampling adequate, are the methods of acquiring the data reliable, and are the interpretations and classifications of the various classes of behavior just and accurate? Professor Kinsey has gone to considerable lengths to justify his sampling procedures, employing a method similar to that used by the opinion surveys. He also assessed and determined the number of cases necessary for an adequate sampling. It is, however, difficult from the text to determine whether or not the composition of the various breakdown groups is reliable and sound. One's suspicion is nowhere allayed that perhaps inmates of penal institutions or aberrant social groups are overrepresented in what purports to be cross-section samples.

The personal interview, as a method of acquiring data on a subject such as this, has seemed to some critics to be unreliable. Since it is the only practical method available, it has per force been adopted. Kinsey, however, after employing various check devices, feels assured that the method in skillful, experienced hands is reliable. One of the major difficulties, however, is the matter of recall. How accurately can one remember events or frequencies that took place 20 or 40 years ago? No doubt certain episodes make a vivid impression, but others that become routine are less likely to be as accurately recorded in the memory. The author's tests on recall are to my mind rather less convincing than he asserts.

Finally, without going into further reservations and queries, I am somewhat dubious of the classification of certain forms of behavior as homosexual. It seems to me that this rubric has been used too generously as a classificatory pocket for various forms of preadolescent activity. The point that the authors make in this connection is amply supported without straining the classification of the data themselves.

Professor Kinsey and his associates have in this volume produced an astounding mass of material which should be studied critically by those qualified to do so. I hope that the examination of their results will be carried out in an attitude appreciative of the difficulties inherent in the nature of this investigation. There can be no question that the work they

have done represents a reorientation in the field of sexual behavior in man.

HARRY L. SHAPIRO.

## THE WAYS OF FISHES

- by Leonard P. Schultz with  
Edith M. Stern

D. Van Nostrand Company, \$4.00  
264 pp., 80 figs.

ACCORDING to the author's estimate, there are forty thousand different kinds of fishes. This provides an almost limitless field for observations of their ways.

We already have some well-known fish books written by ichthyologists for laymen (and used by their authors' colleagues more than they ever anticipated): David Starr Jordan's *Fishes*, J. R. Norman's *A History of Fishes*, and Louis Roule's *Fishes and their Ways of Life*. Although these deal to a large extent with the same material, each is fascinating reading even if you have already read the other two, and each contains material not present in the others. The same can be said of Dr. Schultz's book.

The jacket states that *The Ways of Fishes* is one of a new group of books dealing with various fields of natural history, designed for the entertainment and information of the general reader. The authors of the series are members of the scientific staff of the Smithsonian Institution. Dr. Schultz says that his object in writing the book is "to share with others who are not ichthyologists at least a little of the enjoyment my colleagues and I get out of knowing the bizarre, astonishing, and manifold ways of our favorite animals." Much of the charm of this book lies in the author's world-wide, firsthand observations and his obvious pleasure in making them. Another stimulating feature is the up-to-date descriptions of the large and small experiments, discoveries, and problems of Dr. Schultz's colleagues: the search for the Bantam Champion—the smallest fish in the world, the description of the three fishes that have held this honor (backed by Drs. Girard, Garman, and Hugh M. Smith respectively), and the subsequent efforts by Drs. Lönnberg and Henn to find another champ; C. W. Coates's and Richard T. Cox's explorations into the ways of the electric eel; C. Tate Regan's discovery of the hitherto unknown male of a deep sea angler fish, infinitely smaller than its mate and dangling from her cheek; Dr. Schultz's own observations on the timidity of sharks and the wounds inflicted by the sting ray, etc. There are also very fine chapters on Sound and Sight, Migration, Locomotion, Feeding Habits, Fishes Dangerous to Man, and even a section on Home Aquaria and fishes suitable for them. The final section is a classification of fishes, which should



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prove of use to laymen and certainly is of interest to ichthyologists.

I suspect that the first orders for this book will come not from "others who are not ichthyologists" but from Dr. Schultz's ichthyological colleagues.

F. LA MONTE.

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Curator of Fishes, Smithsonian Institution  
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## WILD FLOWER GUIDE

----- by Edgar T. Wherry

Doubleday and Co., \$3.00  
202 pp., 106 plates

ALL the so-called "wild-flower books" suffer from the same trouble: they are restricted in their scope. They include many plants which one may never see around his home and omit many others which are locally common or conspicuous. Dr. Wherry's book is no exception. He describes and Miss Hoffman illustrates 500 kinds out of a total of possibly 2500 kinds of plants that deserve the name of wild flower. No two persons would make the same selection; no person would fully agree with Wherry's choice, but, being an expert botanist and thoroughly familiar with the flora of the region, he has certainly done as well in this respect as any other author and far better than some have done in the past.

The first section of the book includes 400 native plants, and this is followed by a second part with 100 foreign species. This is unfortunate, since most readers will not easily decide whether a wild flower is native or foreign, and it also compels them to search on widely separate pages for some closely similar plants, such as the foreign Rocket and the native Wild Rocket. The book includes simple keys to the families, but under each family the plant must be identified by the brief descriptions and the illustrations. In making the pictures, Miss Hoffman has lived up to her reputation as a botanical artist. While small, they are clear and accurate. Half of them are in color, and the colors are reproduced with unusual fidelity. White flowers are mostly shown in black-and-white figures, but a few are shown in color plates. In these cases—and the Great Trillium is an example—the flowers that are supposed to be white have color in them.

H. A. GLEASON.

### BEE'S WAYS

----- by George DeClyver Curtis

Houghton Mifflin Co., \$2.75  
240 pp., 14 decorations

THE present book derives part of its justification from the fact that it is written by an apiarist with over 37 years' experience. Its title might almost as aptly have been "My Adventures with Bees," for the information that the author imparts, while sometimes derived from reading, has for the most part been gathered while manipulating and observing his

bees. The preface states that the book is intended for those "who might like to find out in a casual and painless sort of way the main facts in the life of the bee." Such an approach has something in its favor and will meet the needs of a casual reader, but it lacks the ordered completeness of certain of the standard works on the subject.

It is doubtless because of the existing close partnership between man and the bees, strengthened with the passing years, that the author has permitted himself every now and then to give his bees a personality that a more scientific interpretation would hesitate to accord them. But even in a popular book it is questionable whether it is wise to go to the length of recording imaginary conversations between worker bees designated "Miss Beatrice," "Miss Belinda," "Miss Beulah," "Miss Phoebe," and "Miss Beebe," or to try to figure out what is passing through the brain of a bee.

The book cannot be read uncritically because some of the statements are lacking in precision, but as a completely non-technical presentation of the subject, coming from a man who has lived with the bees for several decades, it will commend itself to certain groups of readers.

HERBERT F. SCHWARZ.

### THE GREEN WORLD OF THE NATURALISTS

----- selected by Victor Wolfgang  
von Hagen

Greenberg, \$5.00  
392 pp.

FIVE centuries of natural history in South America are presented in this volume by one who knows this literature and who has in his previous books done much to keep it fresh for present-day readers. The roster of naturalists who have delved into their favorite fields in South America and then have given us a pen picture of what they have observed is most impressive. It includes nearly all the greatest literary naturalists of America and Europe. From the writings of these men, Mr. von Hagen has chosen what he considers the best and most representative examples, and there is no doubt that he has made excellent selections. As a result, the book consists of fascinating specimens of the writings of 25 of these literary naturalists who have described South America in words that are not only accurate but inspired. These include Humboldt, Darwin, Bates, Hudson, Beebe, Chapman, and Murphy.

Mr. von Hagen says, "This is not wholly an anthology of naturalists. Although they are in dominance, it is also a book of literary natural history, written by literateurs who possessed the equipment that William Beebe thought ideal: 'Supreme enthusiasm, tempered with patience and a complete devotion to truth;

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THE AMERICAN MUSEUM OF NATURAL HISTORY  
77th STREET AND CENTRAL PARK WEST. NEW YORK 24, N. Y.

the broadest possible education; keen eyes, ears and nose." Among these selected writings we find the first description of rubber; early accounts of Indian bread, maize, cacao, quinine, curare; cameloids of western South America; tortoises of the Galapagos; the note of the Bellbird; and many other surprising objects and phenomena. Toward the end of the book we find Chapman, characterized as the greatest figure in ornithology since Audubon, with two essays from his Tropical Air-Castle in Barro Colorado, and Murphy with an essay on the Guanay of Peru.

The book is annotated by Mr. von Hagen, who has also prepared biographical sketches of the naturalists included. It is altogether a fascinating volume

CLYDE FISHER.

## NATURE LOVER'S TREASURY

----- selected and edited by  
Marshall McClintock

Greystone Press, \$3.50  
790 pp.

ANTHOLOGISTS usually are liable to harsh but often unfair criticisms, not because of what they have put into their anthologies, but because of what they have left out. If Marshall McClintock has committed the anthologist's sin of omission, we have hope for his forgiveness because of his virtues of inclusion. Some anthologists write lengthy forewords which they hope will justify their choices. Not Mr. McClintock, and more power to him! He does not waste a page on such unnecessary appeasement. There is just a title page, a table of contents, and then all the rest of the 800-page volume is crammed full of some of the finest works in nature literature. McClintock gives "Nature" the broadest possible definition, and over 100 selections from the works of over 80 noted writers

fill his book with accounts of high adventure, exploration, tales of men and beasts, and of the elements.

The reader observes the natural world through the eyes of such illustrious writer-naturalists as Muir and Burroughs, Thoreau and Fabre, Darwin and Huxley, and Beebe and Akeley. Here the reader can explore with Captain Cook and Stefansson, Agassiz and Tyndall. The mysteries and beauties of Nature find expression in selections from the poetry of Keats and Blake, Browning and Burns, and Whitman. The tales and accounts of masters of narration and description include selections from Stevenson, Hudson, Conrad, Poe, London, H. G. Wells, John Steinbeck, and Marjorie Kinnan Rawlings. Rare gems in this treasury include such little-known but worthy pieces as Lafcadio Hearn's "The Storm" and "Battle with a Whale" by William M. Davies.

Lest some be wary of this invigorating anthology because of the title, *Nature Lover's Treasury*, let the reviewer state that it is evident that the anthologist assumes the love of Nature to be universal. It is, therefore, a treasury for all readers.

JOHN R. SAUNDERS.

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*Photo by Edison R. Hoge, courtesy California Institute of Technology*

▲ PALOMAR MOUNTAIN OBSERVATORY where the California Institute of Technology's big 200-inch telescope is now nearing completion. The height is

equivalent to a 12-story building. The dome houses the telescope and its machinery, visitor's gallery, darkrooms, offices, and other facilities



HIGH on a lonely mountaintop in Southern California, men of science are driving toward the early culmination of 20 years' effort.

Palomar's mighty telescope—the largest precision instrument ever devised—is scheduled within the next year to begin exploring the inscrutable “outer darkness” of the universe, there to search out worlds hitherto beyond man's farthest reach.

More thrilling than any mystery novel is the story back of this 200-inch sky searcher. Like all well-plotted stories, it is replete with conflict and suspense; for, above all, this was no Arabian Nights project. No wishful-thinking Aladdin simply passed his hands over a magic lamp and stepped casually aside while the finished product was set before him.

Rather, the Palomar project came into being deliberately, painstakingly, laboriously; inch by inch, plan by plan. The result is a mathematical prodigy, born of science and industry.

This is not the first telling of Palomar's story; nor will it be the last. Better may it be termed the résumé of a thousand stories, for over a considerable portion of his adult life Mr. Average American has been scanning press notices concerning the instrument's progress.

Twenty years ago this spring we read that Dr. George Ellery Hale, of the California Institute of Technology, had petitioned the Rockefeller Foundation for a grant of \$6,000,000. The funds, according to Dr. Hale's proposal, were needed for creation and installation of a telescope twice as huge as the 100-incher on Mount Wilson, then the world's largest. Because the project seemed fantastic beyond all reason, we were perhaps just a little surprised when the appropriation was granted.

It was sometime later that we again had the telescope's progress recalled to us when we picked up our morning newspaper to read that a 20-ton pure quartz disc, intended for the primary mirror, had been flawed in casting and thereby rendered useless. In 1934, we were

# Palomar-

## MAN'S FARTHEST REACH

What will this giant 200-inch telescope discover in the inconceivable vastness of space that since the Beginning of Time has lain beyond man's farthest reach?

By NELL MURBARGER

told that a second disc of pyrex glass had been poured by the Corning Glass Works of Corning, N. Y. Inasmuch as a sudden change of temperature might check the glass, we read that about a year under controlled heat would be required for its cooling.

Actually this took 300 days, and one day America's newspaper readers were informed that the immense disc had cooled to the satisfaction of all concerned, that it had been found perfect and was now ready for shipment to Pasadena, where “Cal Tech” would take charge of its grinding, polishing, and subsequent installation. Through columns of the press, we followed the mirror's trek across country via a special railway car. To avoid low bridges and tunnels of insufficient size to permit its passage, it was necessary that the route taken be long and circuitous.

Not until 1936, eight years after granting of funds for the project, could actual work of grinding the mirror get under way. During the next eleven years—excepting for the war years (1942-45) when all work on the project halted—optical technicians using abrasives ground away more than one-fourth of the 20-ton glass wafer, whittling it down to a mere 14½ tons.

It was during this laborious process that an always skeptical public began doubting if anything would ever come of “The Big Eye,” as the newspapers had dubbed it.

“What,” quipped the *Chicago*

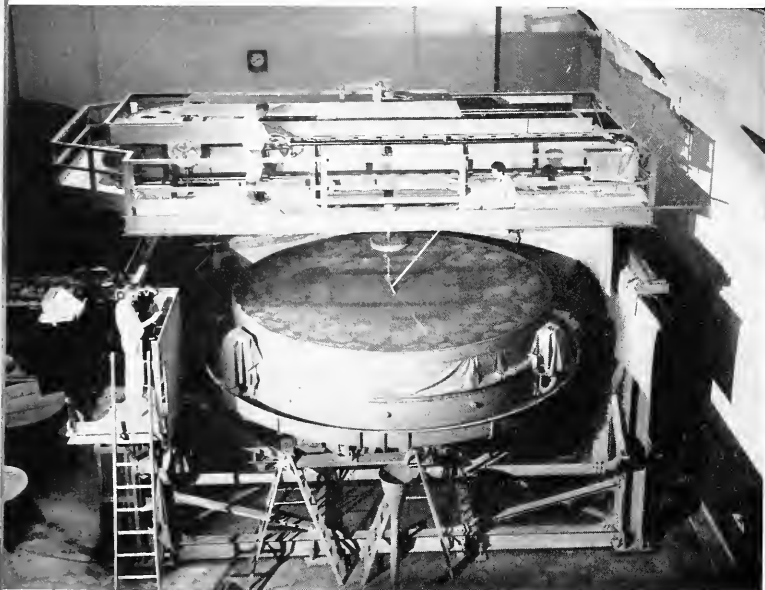
*Daily News*, “does anyone these days hear of that 200-inch telescope that was going to settle how high is up?”

But like the barber in our Third Reader who “kept on shaving,” the technicians—and carborundum grit—kept on grinding.

In the course of its completion, on which was expended 180,000 man-hours, the disc was corrected to such precision that nowhere on its 17-foot diameter was there a deviation of more than two millionths of an inch. Persons whose daily problems seldom involve millionth-of-an-inch calculations get a better idea of this figure when told that if a single strand of spider web like those used in optical instruments were split into 25 equal parts, each part would have a diameter approximately that of the mirror's permitted tolerance.

Late in the autumn of 1947, it was announced that the exacting 11-year-old task of grinding and polishing had at last reached completion. Now remained only the perilous proposition of transporting the Big Eye to its mountaintop aerie, whence it would peer a billion-odd light-years into space.

On November 18, 1947, there rolled away from Cal Tech's optical laboratory a ponderous trailer truck, owned by Belyea Truck Company of Los Angeles, propelled by a Diesel engine of 150 horsepower, and escorted fore and aft by an armed motor guard of Highway Patrol officers.



*Photos courtesy of California Institute of Technology*

◀ **GRINDING MIRROR:** The Palomar mirror was ground and polished in a specially built optical shop on the Cal Tech campus. The job was started in 1936 and completed in 1947. It took approximately 180,000 man-hours to complete the mirror

Loaded on the truck's 16-wheel trailer was that all-important glass disc, insured by Lloyd's of London and other underwriters at \$600,000 but in reality, priceless. Who can place a dollar-and-cents value on the hope and labor of 20 years?

The Big Eye, with its mounting mechanism and cell, its shock-cushioned and insulated packing case, and the trailer body that carried it, tipped the scales at a cool 70 tons. To safely support a weight of such immensity and concentration, it had been necessary to reinforce five culverts and three bridges along the 160-mile route. In instances where engineers still harbored doubts of a crossing's stability, dollies bearing 16 additional rubber-tired wheels were brought into use on the trailer. "Vibrometer" gauges, affixed to the mirror itself, gave instant warning whenever road vibrations approached a point where the precious cargo might be endangered. In open country the truck held to an average speed of nine miles per hour, reducing to three miles as it passed through each of the several towns en route.

Cal Tech officials would have preferred to keep the big disc's cross-state migration a secret.

Knowing that this was impossible, they sought and obtained almost unprecedented peacetime co-operation from both the press and radio. The press was kept informed well in advance of every step in preparation for moving and also told when the move would start, the route it would follow, and all other pertinent information. As a result, actual announcement that the mirror was on the way was not made until more than eight hours after it left the Cal Tech campus. By then it was through congested traffic districts and in open country.

Even with this much secrecy, word sped ahead of the caravan, and in every community crowds began to gather to watch the slow-moving, police-cordoned procession. School classes were even dismissed so that pupils might witness the history-making journey. Although several letters had been received previously from cranks about persons who might wish to destroy the mirror if given an opportunity, no attempt at sabotage was made.

After spending the night of November 18 at the small foothill town of Escondido, where a heavy police guard was thrown around the curb-parked trailer, and traffic

was rerouted as a protective measure, the last leg of the journey began at the chill, predawn hour of five o'clock, on the morning of November 19.

Up the narrow road that winds to the lonely 5567-foot summit of Palomar Mountain headed the official caravan. Due to the grade's steepness, it was found necessary to engage two additional trucks—each equipped with a 150 horsepower Diesel engine. Two pushed the trailer from behind, the other was coupled to it in front.

With all other traffic barred, the cortege inched its way up the mountain, the grueling ascent being accomplished at three miles per hour. Adding to the hazard of sharp curves and steep grades, the caravan was for six hours bedeviled by every caprice of winter weather known to Southern California's mountains. Hail, sleet, and a pea-soup fog made the roadway treacherously slippery. Visibility at times was near zero.

When the powerful trucks and their all-important cargo rolled safely to a stop before the hangar-sized doors of the observatory, it is impossible to say who was the most relieved—Dr. Ira Sprague Bowen, Director of both Palomar and Mount Wilson Observatories, or veteran truck drivers Lloyd Green and Earl Winston, who had taken turns shepherding the lead truck throughout the 160-mile trek from Pasadena.

Barely had the wheels stopped rolling when the sun broke through the enveloping clouds, bathing the great dome in light, as though to welcome home this prober of the universe. But the gesture of good will was short-lived. Within a few brief moments the early winter

storm again had closed upon the mountaintop.

Lifted from the trailer by means of a 60-ton hoist, the 200-inch disc was deposited in a high-vacuum aluminizing tank. Therein the face of the glass wafer received a coating of aluminum film some 10-millionths of an inch in thickness, which serves as a reflecting surface.

For the first time in its long period of gestation, the Big Eye actually merited the designation of "mirror."

Through all the years devoted to its perfecting, other technicians had been engaged in erection of the observatory dome and installation of its complex mechanical equipment.

But for its greater size, this structure built to house the Big Eye differs not too radically in appearance from other observatories that have preceded it. Forming the top half of the building—a structure roughly twelve stories high—is a steel dome 137 feet in diameter and weighing 1000 tons. Despite its ponderous bulk, the entire dome can be made to revolve soundlessly on a circular track. Split shutters ride on horizontal rails.

Occupying the first and second floors of the dome building are administrative offices, photographic darkrooms, air-conditioning equipment, library, storage area, etc. On the third, or "Observation Floor," is located the 55-foot telescope tube, its muzzle pointed toward the shut-

ter opening like a Gargantuan cannon. Together with supplementary mirrors and other prescribed equipment, it tips the scales at another 140 tons. Everything connected with the Palomar project is ponderous.

With aluminizing completed, the primary mirror was hoisted into place and made fast at the lower end of this giant tube, and tests to remove the final "bugs" got under way. (Many preliminary tests of the mounting mechanism had been accomplished by using a block of concrete of identical weight as a "stand-in" for the mirror.)

When Palomar officials held "open house" for press representatives on January 30, 1948, I was fortunate in being among those permitted to witness preview operations of the sky giant.

Like a well-trained dog being put through his paces by an exacting master, this mightiest of all precision instruments was made to obey the push-button control of man. To the uninitiated, the 'scope's instrument panel rivals in complexity that of a B-29 bomber!

The mirror's million-pound mounting mechanism, it was demonstrated, turns smoothly upon a micro-film of oil, so little effort being required to impel it that one-tenth of one horsepower would suffice for the operation. (The diminutive motor on your electric washer is probably one-quarter horsepower—or strong enough to operate simul-

taneously three of these delicately-balanced million-pound machines!)

As for the working accuracy of the mirror and its mounting mechanism, Westinghouse engineers declare it comparable to aiming a rifle at a rolling penny three miles distant—and hitting the bull's-eye, first shot.

While the telescope, or "camera," as technicians prefer to term it, is already in condition for use, many additional tests are scheduled before the Big Eye is formally dedicated and placed in official use, possibly about midsummer of this year.

To the Carnegie Institute and the Rockefeller Foundation, the completed observatory will represent a cost of \$6,550,000. To California Institute of Technology, it will represent the hopes and planning and patient labor of two decades.

What will be the reward?

None can say. Until actual observations can be made, Palomar's potentialities are restricted only to the realms of mathematics and imagination. Immensity of space being otherwise incomprehensible, searchers of the cosmic have conveniently reduced astronomical mileage to light-years—the distance traveled by light in 52 weeks. Moving roughly at the rate of 186,000 miles per second, one such light-year amounts to the staggering total of some 6,000,000,000,000 miles.

Mathematicians have computed that Palomar's 200-inch mirror will probe the secrets of space a *billion light-years distant*. Thus does the matter of reducing the Big Eye's seeing power to terms of miles become a simple matter of writing the numeral "6" followed by 21 zeros.



◀ ON THE WAY: the 200-inch mirror is shown being moved from Cal Tech campus to the Palomar Observatory. Notice the 16 additional wheels being attached to the trailer carrying the mirror. The caravan is preparing to cross the long bridge near San Juan Capistrano

The result is a figure few men can read and none can comprehend. Not even is it comprehensible if we say that such mileage equals 25 million billion times the distance between the earth and the moon!

What will science find in this "outer darkness," this inconceivable vastness that since Time's beginning has lain beyond man's farthest reach?

Again, no man can say.

Chiefly, Palomar's talents will be turned toward probing the secrets of the cosmic, and to confirmation—if possible—of numerous unproven theories.

Is our universe young and rapidly expanding, or is it old, weary, and shrinking? Is space somehow limited, or is it without end? Philosopher Herbert Spencer said that it was impossible for the human mind to conceive of space being without end, "yet it cannot think of space having an end . . ." Perhaps it will be given to Palomar to supply the answer.

Science has a lot of other questions to ask, as well. What is the source of chemical elements? Whence come atom-splitting cosmic rays? What is the secret of the unending interplay of atomic energy in space? What goes on in celestial atomic fires? Are there galaxies similar to our own Milky Way galaxy at regular intervals throughout space? What is the source of the sun's stupendous energy, an estimated equivalent, per second, of 5000 billion atomic bombs!

With such an imagination-stirring program in prospect, it is not difficult to understand why Palomar's tremendous "seeing power" will not be squandered upon such "next-door neighbors" as the moon.

What about Mars?

"I'll be surprised if we spend more than a few days on Mars in the next ten years," Dr. Bowen says. Some planetary work will be done at appropriate times in the future. Because of its greater light gathering power, the 200-inch will enable astronomers to take much faster pictures than heretofore possible. Such "snapshots" will be attempted when the times are right for them, but the question of whether or not

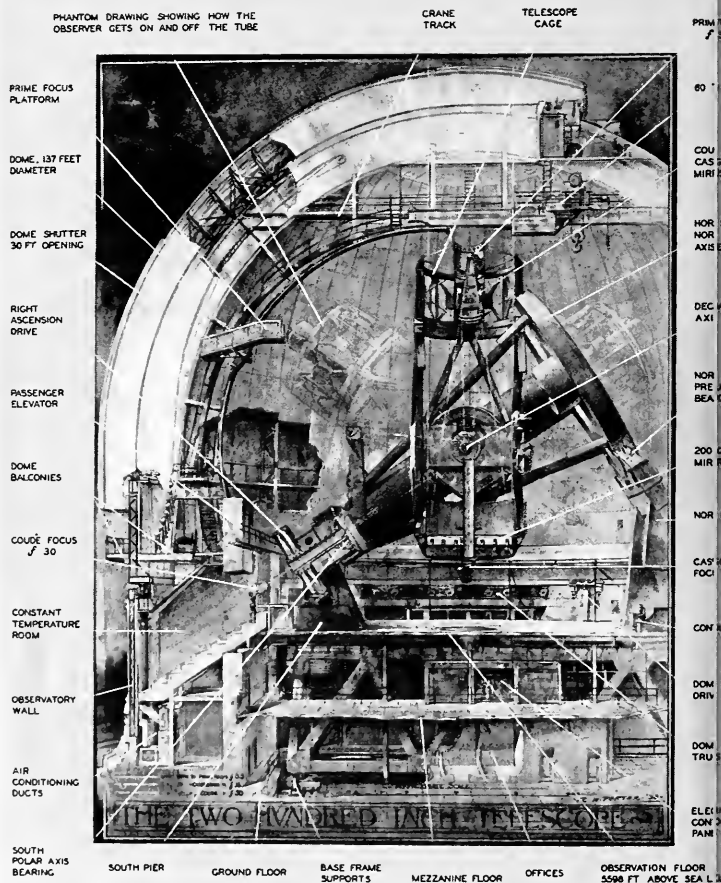
they will add anything to present planetary theories—particularly as to life on other planets—will be determined only when and if the pictures are obtained.

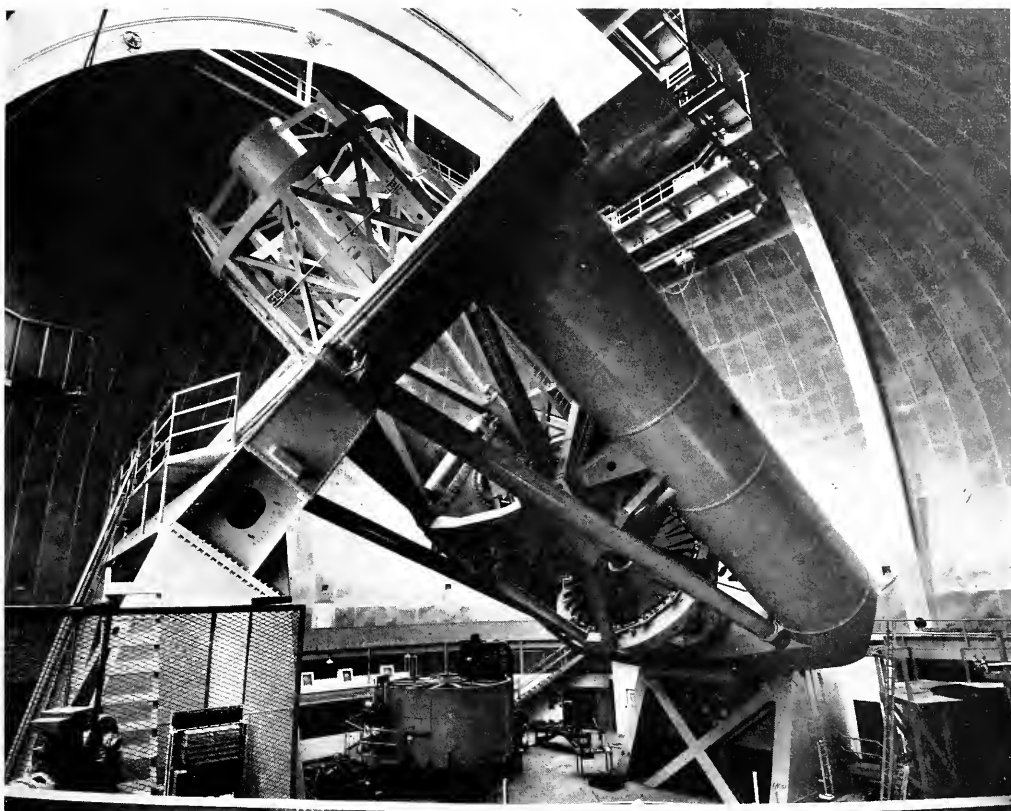
With so limitless a field waiting to be explored, it would seem that life could hold no more exhilarating experience than that of "first peek" into the giant sky glass.

Unfortunately for romanticists, this is not an instrument for visual use. While the image reflected upon the primary mirror will be readily visible to the naked eye, all serious study will be conducted solely by means of photographs. In explanation of this policy, Cal Tech

officials point out that each view thereby becomes a measurable record, preservable for all time, available to all astronomers for purposes of study, and subject to interpretation by many scientific minds rather than by a single observer. Further, since they may be exposed to a given object for several hours, if necessary, it is possible for photographic plates to record light invisible to the human eye.

As during the latter years of construction, laymen will be welcome to view the telescope and such operations as may take place between the hours of 9 A.M. and 4:30 P.M. daily, such observation





▲ NOW NEARING COMPLETION atop Palomar Mountain. The mounting mechanism weighs more than 500 tons but can be moved with a 1/10 horsepower motor

*Photos courtesy of California Institute of Technology*

being restricted to the vantage point of a glassed-in visitors' gallery located on the same floor as the instrument.

Glass partitioning between the visitors' gallery and the actual scene of operations is not solely to keep little boys from throwing monkey wrenches into the machinery. It is also designed to combat temperature change inside the dome. The gallery is separately ventilated, which, together with the natural insulating properties of its glass walls and ceiling, prevents body heat of visitors from entering the dome. The body generates about 500 BTU's per hour. Fifty or a hundred visitors can, as one of the engineers explains, "generate a lot of heat." Allowed to enter the dome, this additional heat would make it more difficult to maintain

the proper balance between inside and outside dome temperatures. The dome has an air-conditioning system and insulation calculated to hold temperature rise to a minimum. The less waiting that astronomers must do to allow the mirror to adjust itself to outside temperature, the more time they will have for observation.

Viewed from a pre-operation standpoint, it appears that nothing has been overlooked that might contribute one iota to successful performance of this sky giant, conceived so long ago. Certain it is that when the Big Eye is at last placed in service sometime this summer, there are two men who will realize in this achievement a greater satisfaction than anything else life might bring.

They are Dr. John A. Anderson,

71, Chairman of Palomar's Construction Committee and Executive Officer of the Observatory Council, and Dr. Max Mason, 70, Chairman of Observatory Council and Policy Committees. These two were cited recently by Dr. Lee A. Dubridge, President of California Institute of Technology, as the men still living who have contributed most to the success of the Palomar project.

To the regret of all who may attend the dedicatory service, those present will not include Dr. George Ellery Hale, "father" of Palomar, whose death occurred ten years ago, when his dream project was only half completed though far enough on its way to assure its transition from fancy into fact.

If spirits of the departed can look back on earthly affairs, as some believe, it is certain that Dr. Hale can feel only satisfaction and pride in the way that others have completed the immense task that it was his privilege to begin.

IN all the world there is only one live volcano that can have its birthday celebrated, only one whose date of birth is known. A little over five years ago—to be precise, at 4:30 in the afternoon of February 20, 1943—the first rocks and dust were ejected from a hole in a cornfield where there is now a pile of rocks 1500 feet high. The base of this pile is submerged in a 300-foot sea of solidified lava. Parícutin's birth was crowded from the news pages of the world by reports of battles and bombings, and few scientists could get to Mexico during the early days to see this new wonder of the geological world. News interest died before news space was available, but to vulcanologists it is still the world's most interesting laboratory.

To observe and record Parícutin's behavior five years after its birth, the fourth expedition from the American Museum of Natural History went to Mexico at the invitation of Ing. Ricardo Munges Lopez, head of the Instituto de Geología of the National University of Mexico.\* Parícutin is still a magnificent spectacle and still worthy of a visit from tourists and geolo-

\*The earlier phases of Parícutin's development were described by Dr. Pough in two other articles in *NATURAL HISTORY*: "Parícutin" (October, 1943) and "Parícutin Comes of Age" (October, 1944).

gists alike, though its activity is showing signs of cessation.

We found that the volcano had grown little higher in the two and a half years since the Museum's last expedition. Indeed, the cone actually appeared lower than at that time, because its old base, Dionisio Pulido's carefully tended cornfield, is now 300 feet deep in lava. This tremendous thickness of lava has washed over the subsidiary flanking cone, Zapicho, which had risen 300 feet in a few months. Zapicho exists today only in the memories of those who visited it earlier and

in the photographic records of the geologists. To the north there had been a great hill of ash-covered lava, which was a wonder because of its origin. It had broken off as a fragment of the original cone and floated out a half-mile on the back of a flowing glacier of lava. On our recent visit it showed only its crown in a small depression in the midst of a recent flow.

The twentieth of February was a propitious day for our observations. A lava flow that had sprung from the flanks of the cone near the old Zapicho vent was advancing



# PARÍCUTIN

## has a Birthday

Exactly five years after its birth, the famous Mexican volcano still provides a magnificent spectacle but is showing signs of age

By FREDERICK H. POUGH

*Curator, Department of Physical Geology and Mineralogy,  
American Museum of Natural History*

▲ THREE HUNDRED FEET of lava now fills the valley that lay between the cones of Parícutin and the ridge from which this photograph was taken. Near the base of Zapicho, the subsidiary cone, is now buried in lava

➤ ONLY THE TOP of the church is now visible above the lava flow that covered the village of San Juan. Note the maguey that still survives on the edge of the old town

*Photographs by the author*



toward the geologists' cabin, now perched on the last remaining summit of the old land surface. By now the cabin may be buried. We could reach the source of this lava only by a perilous journey along a narrow route between the advancing river and the cone. There was an ever-present threat of a shower of bombs, from which there would be no escape. After much activity the day before, the eruptions subsided so that it seemed safe to make the attempt. A sharp break bisected the formerly symmetrical cone, and the lava escaped from a vent at the base of the fissure. The lava was seen to be flowing freely from the source and tumbling rapidly down a steep bank. From time to time its surface would heave, almost as if it were breathing. After some minutes of observation from this spot, the party climbed higher for a better view and reached a point of vantage above an upper vent, which was the source of a second slow-moving stream of black lava upon which the bombs from the cone were tumbling. Fortunately, most

of the bombs followed the groove made by the fissure in the cone, and few surmounted our observation point.

A few minutes after we reached this spot, the lower and apparently harmless vent commenced heaving with greater force. Soon it rose in a tremendous fountain of red lava, its solid part rising to our level, while spattered fragments reached well above us. Fortunately, none of these came in our direction. The still warm spots that we had just left for our upward climb were liberally plastered with great viscous chunks of lava, which completely coated all the vicinity with red, slaggy stone. The whole spectacle was terrifying, and at its climax the lava masses came disturbingly close. However, within a minute the fountain stopped very suddenly, and after a few more minor heaves the river resumed its quiescent flow. The whole display was magnificent though brief, and there was time for only a few photographs and a short motion picture sequence.



▲ A CRACK in the ash that covers an old lava flow, showing that the underlying rocks are still adjusting themselves

▼ THE FRONT OF THE CHURCH is all that shows above the lava that engulfed San Juan in 1944. Entrance is gained through a window, as shown here



This display was, in truth, so spectacular and frightening that the project of continuing the climb to the top for a look down into the crater seemed almost an anticlimax. Having escaped Scylla, Charybdis could hold no fears for us! Climbing to the top, however, was a tedious job, even though we were already almost one-third of the way up. Spiraling around the cone to get away from the path of the falling bombs and to make climbing easier, the first man reached the summit after about one and one-half hours. Climbing at an altitude of 10,000 feet with two

cameras and a tripod, on a slope of about 35 degrees and composed of loose, sliding dust and rocks, was no easy task. During the uppermost third, the rocks an inch beneath the surface were so hot that one's finger tips were burned when their aid was enlisted by the climber. Two years of desk work since the last trip were not the best training for the climb, so I arrived at the summit considerably later than the others. The ascent took me about 135 minutes, the descent but 5.

At almost exactly 4:30 we were united at the top, and at the moment of my arrival an upward gust of wind blew my straw sombrero over the edge and down into the crater. The peso reward promptly offered for its return was not accepted, so down it went on the expense account: "One gift to Parícutin for its fifth birthday."

Within the crater we saw a wonderful spectacle. Dropping steeply off, the crater descended in a bowl-like shape for some 200 feet; then a rather sharp drop-off concealed what was below. Several vents were producing steam and dust, and at times the whole 1000-

foot bowl was obscured by a cloud of vapor. Briefly it would clear, and we could see a jet of steam periodically bursting from the bottom with an accompaniment of red rocks. The rocks rose high in the air above us before falling back to land somewhere within the crater or crossing the low side of the slumped edge. During the half-hour we spent there, none came in our direction, a circumstance about which we made no complaint. The smell of sulphur dioxide was strong in the air of the crater, which is almost the only place where this gas has been noted at the volcano.

After half an hour, we decided that we had stretched our luck as far as was safe and beat a strategic retreat by a far shorter route than the ascent. We had hoped to photograph our spiral ascent around the cone the next day when it was light again, but a tremendous shower of bombs during the night obliterated all traces of the path.

In spite of the spectacles observed, it was apparent that Parícutin is becoming senile. True, we saw a wonderful lava fountain at close range; but four years ago we could not safely have stayed so near the cone. True, we climbed the cone amid a shower of rocks and had our path obliterated that night. But two years ago we might not have so safely climbed the cone almost at a time selected by ourselves. Parícutin is not growing any higher. It has been practically stationary in elevation for almost two years. Its explosive character is surely reduced; the lava contains far less gas, and its fountains are of brief duration. Every aspect suggests that Parícutin has lost its youthful vigor and is gradually dying down.

Predictions about volcanoes are dangerous; some activity may continue for another decade. Layers of lava will probably pile up here and there, and the ash will drift ever a little deeper. But we venture to predict that Parícutin will grow but little higher and will cover very little fresh ground with its lava. The area of its damage is now circumscribed, and its ring of devastation will grow no larger.



▲ ON THE FLANK of the cone, a bubble bursts at the vent from which the lava is flowing



► INGENIERO JENARO GONZALES REYNA, of the Mexican Institute of Geology, collects a piece of a bomb that fell during the night

# Isabel and Ichabod

The unusual story of as curious a pair of pets as you could have in the home. At birth they could perch on a pinhead. In adulthood they were three to four inches long—tyrants of the insect world but beneficial to man

By KAY ANDERSON

All photos by Edwin Way Teale

HAVE you ever had a Praying Mantis for a pet? If not, then you have missed one of the most exciting and truly novel experiences of your life. Although the praying mantis is really no more than an insect, it is the only insect that can turn its head and look over its shoulder like a man, that can wash its face like a cat, take food from your hand like a dog, and bend over and drink water like a horse.

I remember well the spring day that we found a mantis egg nest in the yard and were introduced to Isabel and Ichabod, who were to become the most unusual and fascinating pets we have ever had. The nest was about the size and color of a walnut and was attached to a bush a few feet above the ground. We broke off the branch and put it in a large glass jar in the kitchen, and before long scores of tiny insects were swarming from their cocoon and hopping around like miniature monkeys. The mantids were wheat-colored and so small that one could easily sit on the head of a pin, where it would immediately assume the identical "praying" posture of its parents. We eventually let loose in the garden all but half a dozen of the

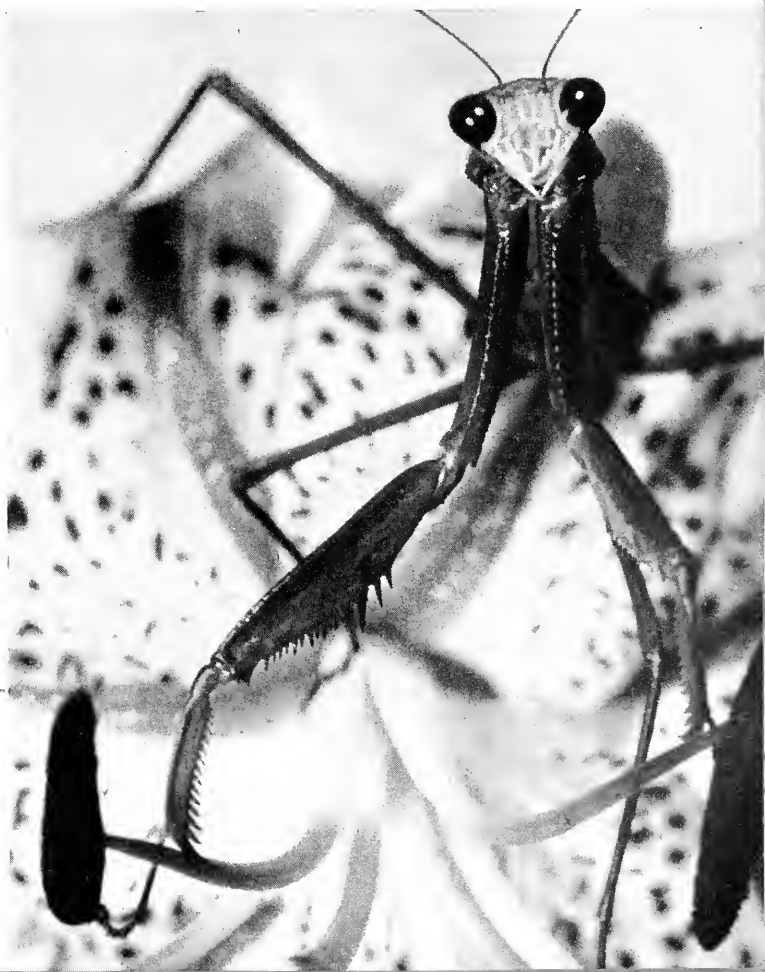
tiny creatures. These six we kept for study and to raise as pets.

We put them in a jar with a piece of cheesecloth over the top so that they would not escape. Since they were too small to eat any living insects that we could provide, we

fed the baby mantids honey smeared on a leaf. They developed rapidly on this diet, and we were soon able to bring them aphids and other live tidbits from the garden.

What is a praying mantis, you may ask? It is surprising how many people—even those who have actually seen this strange creature—have no idea what it is. In the United States they are more commonly found in the South but are now spreading farther north along the eastern coast. One summer I came across a beautiful male specimen walking nonchalantly down Fifth Avenue in New York City, in constant danger of being trampled under hundreds of rushing feet. I carried it to the Library on 42nd Street and deposited it safely in a tree.

The body of the adult female mantis, which resembles that of its



► "THE DINOSAUR OF THE GARDEN," with its slender, almost prehistoric-looking body, its weirdly moving head, and its immense black eyes, is enough to frighten anyone on first encounter



▲ THE GREAT saw-toothed forelegs move with lightning speed and snap shut over a victim like a steel trap

smaller hopping relative the grasshopper, is from three to four inches long and is usually a light brown color. The male is an inch or so shorter and a brilliant green. With the final molting, the mantis develops a pair of wings, which are soft green underneath with a bright green band down the sides. Thus, as the insect hangs in a vertical position along the stem of a flower or shrub, it blends perfectly into its background. Often a person can come within a few inches of these garden Gargantuas and never see them.

They say that the East Indian mantis attains perfection in camouflage by spreading its brilliantly colored wings to resemble the

petals of some lush tropical flower. The unsuspecting insect flies close to the "flower" and is snatched to its death!

One naturalist has referred to the mantis as "the dinosaur of the garden," and indeed the creature must seem like one to all other insects. The slender, almost prehistoric-looking body, with the weirdly moving head and the immense black eyes, is enough to frighten anyone who encounters it for the first time. The great, sickle-like front legs, raised in a praying attitude, move with lightning speed to bring the victim to the strong, greedy jaws. Even the black widow spider is doomed when clasped in these deadly arms. Yet although

it is one of the most rapacious and cruel of all insects, dominating the garden with the merciless cunning of a medieval Borgia, it is absolutely harmless to man.

Our baby mantids shed their skins regularly at first—as often as once a week—and then at intervals of ten days or two weeks, as they neared maturity. Between these periods of molting, their appetites were so ravenous that they would eat almost without cessation, if given the opportunity. In fact, we learned to our sorrow that mantids are just as quick to eat each other as anything else. One morning we discovered that some of our pets had turned cannibalistic and that only four little creatures remained! So we straightway separated them by putting each in a different jar—making quite a display along our window sill, as you can imagine.

As a rule, the mantis is entirely fearless and will confront and fight birds and animals twice its size, often until it is practically torn to pieces. The only insect the mantis seems to have an antipathy for is the ant. Perhaps this is because ants often swarm over the egg nest and eat the helpless creatures when they are hatching or are in the molting stage, as happened to one of our pets. We had been feeding small black ants to the mantids because of the scarcity of other live food; but on a certain morning one of the mantids spurned the ants we gave him and let them run freely around the jar. We left the house for a short while, and when we returned the little mantis was dead! During our absence he had apparently gone through another molting stage, and while his body was still soft and helpless, the vengeful ants had turned the tables and killed him. Nevertheless, a strong and hungry mantis will usually attack an ant without hesitation, if other food is scarce. Our pets ate dozens of live ants during the summer as a supplement to their diet.

You might truthfully say that our baby mantids were "born fighting." And although they were only one-eighth of an inch long and almost transparent when they emerged from the egg nest, they



▲ POISED like a king over a banquet table, a praying mantis studies a captured honeybee. As a rule, the mantis is fearless and will fight birds and animals twice its size

the back. Then the old skin, a complete and perfect shell of the former body, would be discarded, and the "new" mantis, having stretched a quarter to half an inch in length, would dry and harden within a few hours. And the business of voracious eating would begin all over again.

Isabel and Ichabod were soon familiar enough with our feeding and handling of them to take bits of raw meat from the end of a straw, if it were flicked back and forth as if alive, and to drink water out of a spoon. Their daily menu usually consisted of large flies, moths, butterflies, grasshoppers, and juicy caterpillars. In fact, anything that looked at all "buggy" was a delicacy to them.

Our insect pets afforded us many



▲ A PRAYING MANTIS with a captured Black Swallowtail Butterfly. When the insect hangs in a vertical position, the soft green underside of the wings blends with the flower or shrub to act as a perfect camouflage

were exact copies of the adult, and their tiny forelegs were raised like the arms of a Lilliputian boxer, poised to strike at or grab anything that came within reach.

However, like the nursery rhyme about the Ten Little Indians who dwindled away to none, our four little mantids eventually diminished until there remained only two—a soft, buff-colored female that we named Isabel and a bright green male called Ichabod.

As Isabel and Ichabod grew, the "houses" we provided for them had to expand. By the end of July they reached their full growth and development, and we purchased two medium-size fish aquariums for them, using wire screen for covers.

In each aquarium was placed a long, stout branch, forked at one end. Such a stick is essential in both the eating and molting processes. We found that Isabel and Ichabod while eating preferred to cling to it head down, and they fastened their long walking legs onto the twig—again facing head down—prior to shedding their skin.

The molting process was extremely interesting to watch. Constantly stuffing itself with food, the body of the mantis would soon grow too large for the old skin. The skin would then pop open along the back, and the mantis would proceed to pull itself out, just as one would pull out of long winter underwear if it were buttoned up

diversions throughout the summer, one of the most novel being that of "entertaining" our guests. I use the word broadly and somewhat as Nero must have done when he entertained his Roman friends by throwing Christians to the lions. For there is nothing more fascinating, and at the same time more repelling, than to watch a mantis stalk and seize a fellow insect. Isabel's immense eyes, shining like black shoe buttons, would follow her victim's movements with the same hungry look with which a cat watches a mouse. Slowly and almost imperceptibly she would shift her body until it was in a good striking position; then swiftly and surely her cruel, jagged arms would dart out to pinion the unsuspecting prey. So fast did these arms move that a moth in flight would be caught with wings spread. Once we gave two beetles to Ichabod, and he proceeded to tuck one under his arm like an umbrella, while he held the other and ate it as if it were an ear of corn.

By August, Isabel and Ichabod were so tame that we could let them roam freely around our downstairs, much to the consternation of our guests. If friends were not warned in advance, it was indeed startling for them to glance up at a window and suddenly see a monstrous bug making its way across the top of the curtain. Almost like a walking nightmare! Occasionally one of them would make a short flight with its gossamer-thin wings or jump from one piece of furniture to another; but usually they stayed on the window screens.

We kept the two separated at first, aware of their cannibalistic tendencies. When Mother Nature was ready, we reasoned, she would provide a way for them to find each other. If a male moth can detect its female the distance of a mile, then surely Ichabod should be able to find his light-o'-love across a room!

One summer evening late in August, Ichabod slowly made his way to the window occupied by Isabel. Before long the two spied each other, but they warily kept a safe distance apart. Each in turn

advanced and retreated, twisting their pointed little heads this way and that as they followed each other around the curtain, their black eyes shining brightly, their bodies swaying in anticipation.

This went on for several hours, and we were all exhausted by the strain of watching. Then suddenly the waiting was over. Ichabod ventured too close, and Isabel, with a lightning lunge, viciously embraced him in her cruel arms. Ichabod's legs waved helplessly in the air as his ladylove proceeded to devour him, starting with the head!

Poor Ichabod! After he had literally "lost his head" over his inamorata, he clung to her with his walking legs for almost an hour while she roamed about on the curtain. Then she set to work in earnest and consumed every shred of her lover, with the exception of his wings and legs. We hoped that sometime during this gruesome episode the mating process took place. If so, Ichabod's death might not be called wholly in vain.

That fall, Isabel led a busy life, spending most of her days on the window screen, eating flies and moths for a while and finally small bits of raw meat, when live food was not available. She even took a chunk of cooked chicken one night and seemed to relish it!

As October approached and her abdomen grew round and heavy, we kept Isabel in her aquarium so that she could more readily find the indispensable twig on which to place her egg nest. But it was not until the end of the month that she started building. Clinging to her branch head down, she secreted a whitish froth from the tip of her abdomen, moving it back and forth in much the same way that a baker uses a frosting tube to decorate his cake. With the help of small, constantly rotating feelers, she deposited the mass on a twig, molding and shaping it into her nest. It took nearly two hours to complete the job, during which time she constructed corridors and passages, one on top of the other, depositing her eggs in the different layers and never once glancing back at her masterpiece. Soon after she had

finished, the sticky substance of the cocoon hardened into a tough and protective case.

We learned that a female mantis will always build her nest, whether she has mated or not. Spring will reveal to us the sequel to Isabel's love life, for her nest now stands in a large and ventilated jar in the garage, awaiting the advent of warm weather and the appearance of the bees, the buds, and the baby mantids—we hope!

Isabel ate a few meals of raw liver after her egg laying stint, and then she quietly went to sleep. She had grown very sluggish toward the end and barely moved up and down her stalk. At last she became too weary even to hang onto the food proffered her, and it was at this stage that we gently tied her with soft cord to the branch, thus making certain that when she stiffened she would be in a good position for mounting.

Because of its insatiable appetite for the hundreds of harmful insects that invade our gardens each year, the praying mantis is one of man's most valued friends. In some states there is a law against killing it. As we have demonstrated, it can make a most interesting pet. A woman in New York once dressed a mantis in tiny garments, much as one would clothe a small doll. I understand that the Chinese often match them like miniature fighting cocks; and in other parts of the world they are kept in houses to catch flies and mosquitoes.

A praying mantis is sometimes called a "preying" mantis, due to its habit of preying upon and destroying other insects. However, as the mantis clings motionless to a branch or stalk, with its forelegs raised piously to its head, it looks as if it were actually praying. Praying, no doubt, for something to prey upon!

If ever you should chance to encounter one of these grotesque creatures of the insect world, do not harm it. Either care for it as you would any other domestic pet—or let it go its way undisturbed. The mantis will probably do more good for you in the garden than you could ever do for it in captivity.



# "SCORPION" of the Treetops

The terrifying appearance of this shy woodland lizard of our southern states has given it an infamous reputation that it doesn't deserve

By ROMEO MANSUETI

ONE hot summer afternoon in June, after a busy morning of snake collecting, I paused to speak to a group of colored folk idling in a grove of oaks. No sooner had I begun to question them than one leaped up frantically from his prone position and shouted, "Lawd Amighty, mistah, they's ah sco'pion right at yo' haid!"

I turned quickly and beheld a fiery redhead, flicking a pinkish, forked tongue, about three feet above me on a tree trunk. I looked harder and saw that the smooth and shiny creature had four legs and a brown body not as wide as its head. Magnified 100 times, it reminded me of some hideous primeval monster that would put dinosaurs to shame. It was the most fierce-looking animal for its size I had ever encountered.

That was my first meeting with the "scorpion" of the treetops, the greater five-lined skink. I had heard so many tales about the "sco'pion" during past excursions in southern Maryland that I began to doubt its existence. Now the legend leered down at me with unblinking, bead-like eyes. The animal was about nine inches long and a uniform light brown in color except for its reddish-orange head. The latter instantly reminded me of a venomous copperhead snake's crown.

I adjusted my slip noose, which

I used to snare snakes, and moved it cautiously toward the skink's head. The noose dangled but seven inches away when, suddenly, the pinkish tongue flickered rapidly out at me, and in an instant the creature was gone. I looked among the higher branches but could see no sign of it. Turning around to the Negroes, I was surprised to see that they had scattered about ten to fifteen feet from the tree. I asked them if they could spot the creature. They looked at me as if I were mad.

"Yo don't wanta fool wid thet thing, mistah. It's powahful poisonous," one said very seriously.

I tried to explain that the skink was a lizard, a member of the reptile clan, and quite incapable of inflicting a venomous bite. Furthermore, I told them that real scorpions—lobster-like animals related to spiders, which carry a poisonous sting at the end of their tails—are not usually found as far north as this. How the greater five-lined

▲ THE MUMPLIKE JAWS, found only in the male, are blood-red. The color deepens during the mating season. When the eager male, looking as polished as a Beau Brummel with scales, goes out to secure the affections of the nonchalant female

skink received the name "scorpion" is difficult to say. Some of the earliest historical references of the Old South refer to it by that name.

When I left them, their skeptical expressions still revealed their firm belief that redheaded "sco'pions" are dangerous creatures. Here was an unfortunate situation—a native lizard regarded as poisonous. I was aware that but few people know that the Gila Monster of our southwestern deserts is our only venomous lizard. What was the basis of their fears?

Throughout its range—in woodlands and swamps from central Texas to southern Illinois, and from southeastern Pennsylvania to Florida—it is commonly regarded as

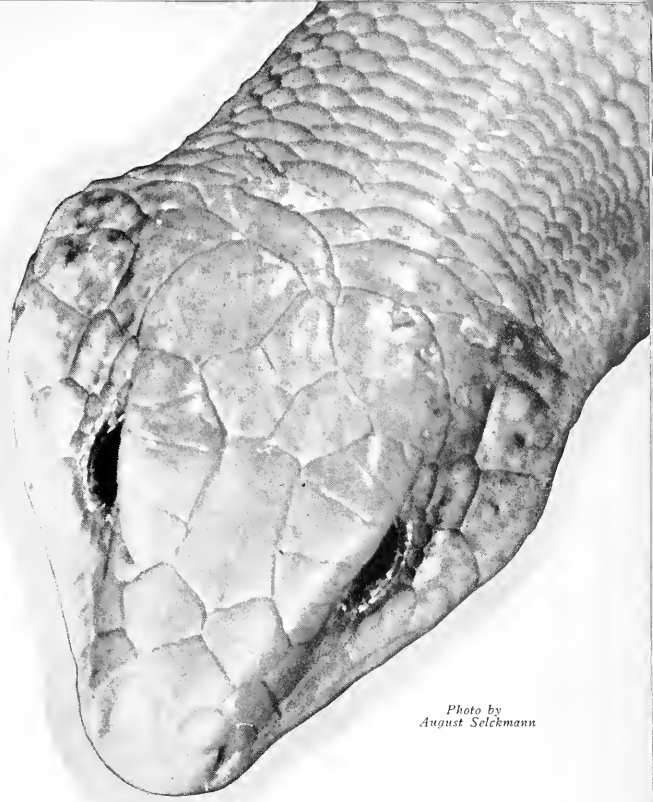


Photo by  
August Selchmann

poisonous by the inhabitants. Most southerners consider the striped skinks harmless enough but greatly fear the redheaded variety, not realizing that the striped and red-headed lizards are one and the same species.

The greater five-lined skink may be called the Dr. Jekyll and Mr. Hyde of the saurian world because of the contrast of color and pattern in one species. Males among birds display more colorful hues than females. So it is with skinks. Only the adult female is striped with a bluish tail, while the mature male parades a blood-red head. Both sexes, nevertheless, begin life looking alike. Juveniles have five yellow stripes—sometimes with an additional poorly defined line beginning behind each forearm and extending backward—and bright blue tails. With the increase of size and age in the female, these characteristic stripes tend to disappear, but vestiges remain. The males, however, lose all traces of their stripes and become brown, while their jaws become reddish and at the same time gradually swell, so that they look as if they had a serious case of mumps. The females exhibit the

light stripes throughout life and often have a blue tail when full-grown. They are somewhat smaller and do not sport the swollen jaws.

This curious attire parallels the development of the common five-lined skink and the Floridian five-lined skink, two very closely related but smaller cousins. To add to the general confusion in identifying these members of the skink tribe, all three may be found in similar kinds of country. Both of the smaller relatives reach a little more than half the size of our giant among American skinks and have the same life history—the males resembling miniature redheaded “scorpions,” while the females retain the stripes.

On hot summer days the greater five-lined skink revels in sunlight, but at high noon it usually remains hidden from excessive heat. It dashes with great alacrity after insects, up and down tree trunks, along fences, in sawmills, and in abandoned houses down south. Here it is sometimes called by such colorful, vernacular names as “adder,” “blue-tail,” “cow-sucker,” and “striped lizard.”

A friend once told me about his

first experience with a redhead: “I saw a flash go up the tree, then my eyes caught the thing staring directly at me, and then its head seemed to light up like a red neon light.” Although the sun’s reflections helped considerably to color his yarn, it is generally known that during the mating season the male’s head is more lavishly adorned in a deeper red.

These skinks spend much of their time on the ground searching for food. When pursued, they sometimes take refuge in holes and cracks very near ground level, not always attempting to climb out of reach. However, ornithologists have found examples high in the nests of birds of prey. One venerable old male that I tried to capture for many weeks always retreated far up a dead chestnut tree that soared many feet above the surrounding scrub pine. Some are so unwary that they will run up small saplings or around tree stumps, making their capture comparatively easy.

In April, looking as polished as a Beau Brummell with scales, glistening males go all out to secure the affections of the nonchalant females. Pugnacious males seem like brass projectiles as they shoot out after rival males trespassing on their territories. They often engage in aerial combat in trees, snapping their wide jaws at one another’s neck or limbs. When one secures a good hold on an adversary, he shakes him vigorously, like a bulldog shaking a cat. The fights are short and packed with plenty of tearing and tumbling, the loser generally fleeing from the territory of the jealous suitor. It is not unusual for the ladylove to be totally unperturbed by the whole affair; she seems more interested in catching insects. In captivity, the female of

Photo by August Selckmann



◀ THIS SPECTACULAR LIZARD, the largest found in eastern United States, is a master of aerial acrobatics, and if you break off its tail, it will simply grow another

the smaller common five-lined skink is much less inhibited. She has been known to attack a male without provocation in order to initiate courtship proceedings.

Although a tree climber, a pregnant female resorts to living on the ground during the egg-laying season. If you dig into decayed logs, particularly ancient chestnut or fallen oak trees, you may find the mother with her usual quota of six eggs. Sometimes she may be found encircling them, though not actually coiled around them. Since her body does not radiate an appreciable amount of warmth, the brooding instinct is interpreted as a protective measure for the eggs.

After about seven weeks the eggs hatch, and the blue-tailed youngsters immediately scramble off for parts unknown. In a few hours they chase tiny flies with great zeal and chew them energetically. The mother forgets about her children a few minutes after they hatch.

When I carried home my first greater five-lined skink, my small brother's first reaction to the name "skink" was to decline it as "skink, skank, skunk," and since no animal exists under the name "skank," he gave that name to the captured skink. Efforts to tame it proved fruitless, but my brother dangled meal worms over its head and succeeded in having it pluck them from his hand. Placing the lizard in a terrarium containing a heterogeneous assortment of reptiles, he noticed that the population was soon mysteriously depleted. At first he suspected that the lizards were escaping from his "escapeproof" terrarium. In a short time he called me excitedly and pointed to an overfat skink. We became sure of "Skank's" saurophagus habits when we discovered our pet in the act of devouring a common five-lined skink. Later we found that it fed on almost all insects that it could catch, crunching beetles with great relish. It is said to break the shells of small eggs so as to lap up their contents. Whether the greater five-lined skink can be classified as a true cannibal has not yet been ascertained. A large redhead that I received from Georgia disgorged a six-lined race

runner when I surprised it swallowing the lizard. The race runner was so long that the protruding tail resembled a thin cigar of the depression era.

While collecting reptiles in Louisiana, I often discovered giant skinks well up the trunks of trees and was able to maneuver them down with a long sumac stem or by throwing sticks and mud above their position. But to capture them was difficult. A soldier buddy once grabbed one and screamed, "I got 'im! I got 'im!" I looked over and burst out laughing. "Look again," I called. He held a wriggling hunk of brown tail—nothing more—and looked as disgruntled as any GI could. The skink seemed to mock us from his perch 20 feet high, but he was tailless.

When I explained that the loss of the tail did not injure the owner, my friend was astounded. He grabbed his next victim carefully and noticed that the redhead seemed to move with lightning speed. This time he succeeded in getting a larger portion of the tail but no lizard.

He observed sagaciously that "All this fellow had to do was to give a twist with his body, and it was all over. But that's rough on the lizard." I countered his last remark by explaining that the animal would grow a new but shorter tail. My friend's retort was, "I'll betcha he won't attract many girl friends looking like that."

When I grasped my first male greater five-lined skink, it nipped my finger viciously with its teeth and viselike jaws. Actually the skin was broken, and a small amount of blood was visible. Other than this sharply painful pinch, I found this skink perfectly harmless and found that it would never attack or bite unless provoked.

Were it not for its shyness and highly nervous disposition, this spectacular lizard, the largest species found in eastern United States, would be better known. In captivity the shock of handling will often cause it to be highly erratic for many days. Father William H. McClellan, S. J., of Woodstock College, Maryland, has succeeded in keeping

them for several years. By erecting a hibernating medium of moistened sawdust or wood pulp with a considerable depth, which closely resembles their natural winter sleeping quarters, he has kept them alive but inanimate all winter in a cold place. In spring they emerged and began to eat normally.

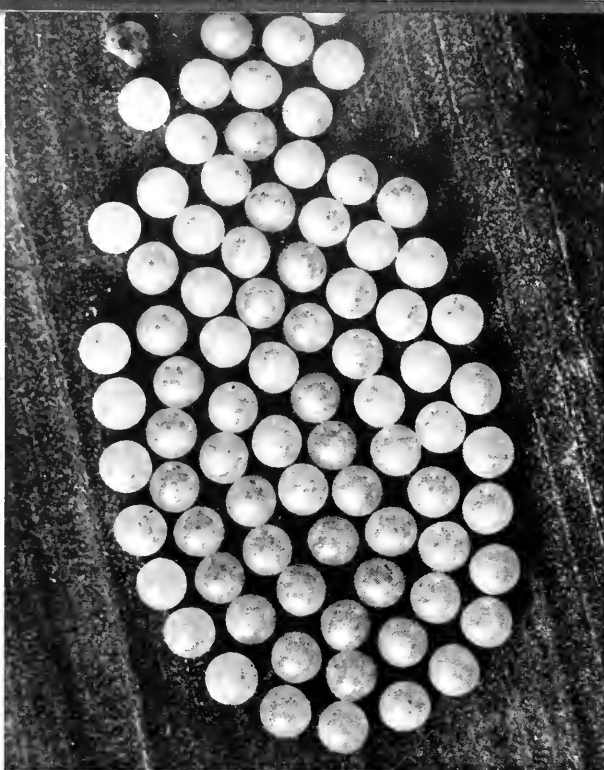
Father McClellan noted that skinks learn to expect food and drink from a customary source and may retain such memories after long interruptions. He records that one mild spring day, one of his newly awakened charges, seeing him approach, came toward him with raised head, expecting to be fed as it had been five months before. He adds, however, "I have never known one to become really tame."

When a greater five-lined skink comes in contact with a black racer, a pilot black snake, or perhaps a rough green snake, it fights with blind fury, making no noises except hisses. Hawks probably eat many skinks, pouncing on them in daylight from above with terrific impact. Young skinks fall prey to most small snakes, mammals, and birds.

Once I surprised some boys who were taking great delight in knocking adult skinks out of trees with slingshots. They bragged that some were expert at bagging them out of trees with stones, while others made excellent scores with air rifles, "just for the sport of it." No doubt in several years their numbers will be greatly decreased, the males, the favorite targets, going first. Old males are often found with deep scars, which they probably received in fights with other males or from encounters with enemies.

This skink has been the taxonomic football of many scientists for about 150 years. It was first made known to science in 1801, by Johann Gottlob Schneider, a celebrated German scholar and herpetologist. He called it *laticeps*, or "broadhead." In 1838, Dr. John E. Holbrook, the "father of American herpetology," recognized and illustrated the large redheaded skink as different from the smaller common species, but he also made the mis-

*Continued on page 240*



▲ Eggs laid on an iris leaf: probably those of the common large iris borer, *Macronoctua onusta*, one of the noctuid moths



▼ Eggs of the Polyphemus moth



▲ ATTACHED to asparagus, these round eggs were presumably laid by a small moth

## WONDER EGGS *of the insect world*

As varied as snowflakes, as colorful as rainbows, these strangely formed and strangely placed eggs possess bizarre characteristics found nowhere else in the whole range of natural history

By EDWIN WAY TEALE

*All photographs by the author*

LILY PADS quenched the drift of my canoe with a soft, sliding murmur. The little cove of the Adirondacks lake was carpeted with the rich green of the floating leaves. Lying there in the breathless still of that summer day, I became absorbed in the activity of a purplish

beetle, about half an inch long, moving over a lily leaf close beside the canoe.

Its long antennae curved downward; it seemed to be examining the leaf as it walked. Half a dozen similar beetles wandered over other leaves around me. All were females

NATURAL HISTORY, MAY, 1948

▼ PLACED on the end of a stalk, the lacewing's egg resembles a lollipop



▲ STRIKINGLY MARKED bug eggs laid on a pine cone. The eggs of the true bugs, the Hemiptera, are the most beautiful and oddly formed of all

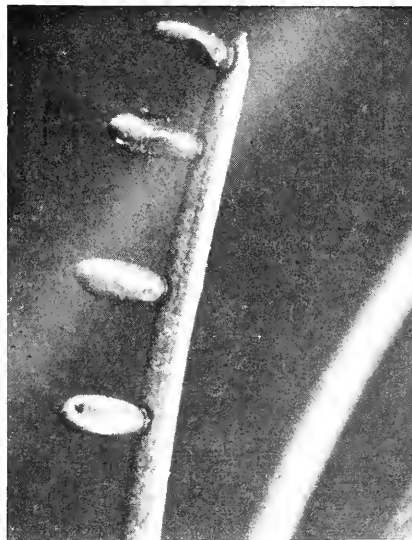
of the species *Donacia palmata*. All were starting anew a remarkable life cycle in which their air-breathing offspring would live several feet below the surface of the water and yet obtain from a curious source the oxygen they needed to survive.

I dragged one of the dripping lily pads into the canoe. On the underside, like a piece of white embroidery, there was a semicircle of whitish eggs running half around a quarter-inch hole in the leaf. A female beetle had bitten the hole through the tissues of the leaf, then inserted the tip of her abdomen into this opening, and cemented the semicircle of eggs to the bottom of the leaf.

When the larvae hatch from these eggs, each is pointed not upward toward the open air but downward into the depths of the water. By grasping little spines against the stem of an aquatic plant, it reaches one of the air sacs within. As a stream of tiny bubbles begins pouring from the hole, the larva corks

up the opening by thrusting its head inside. Here it feeds on the plant tissues and breathes the air until the supply is gone. Then it scrapes its way into another sac. In this way, it obtains food and oxygen during its larval life. Then it spins a little watertight cocoon containing air and within it transforms into the adult beetle. Some of the air catches in the mass of fine hairs on its underside. Buoyed up and supplied with oxygen in this way, it ascends to the surface to spend its adult days in the air and sunshine.

This, then, is the singular story of the metallic-hued beetle I watched that day—a story that was beginning again in the semicircle of elongated eggs beneath the lily pad. Counting these eggs, I found they numbered close to 50. Considering the insect world as a whole, it is estimated that the average number of eggs deposited by one insect is somewhere between 100 and 150. Many species, however, exceed this number by far. Some of the oil



▲ EGGS of the asparagus beetle. Sometimes as many as four parasitic larvae live within one of these eggs, and still a beetle is able to hatch from it



▲ MOTH EGGS laid on a clothesline

beetles of the family Meloidae, for example, lay as many as 10,000 eggs. In the ovaries of a flesh fly, one scientist counted 20,000 eggs. I remember a blue-bodied dragonfly that dropped her eggs so thickly in the water that on two and a half inches of a submerged sweet flagleaf I counted more than 1000. And this was one of the smaller dragonflies. The number of eggs in the larger dragonflies runs as high as 110,000.

And insect eggs are no ordinary eggs. They are wonder eggs. They possess bizarre characteristics found nowhere else in the whole range of natural history. Among them we find eggs that glow in the dark—the luminous eggs of certain fireflies. We find multiplying eggs, such as those produced by Chalcid wasps, in which as many as 2000 individuals result from the laying of a single egg. We find eggs placed within other eggs. In some instances, we even find the eggs of hymenopterous parasites hatching within the body of the mother, and the young beginning to devour her alive. We find eggs so minute they cannot be seen without the aid of a microscope. And we find eggs that are tinted, ornamented, and sculptured like jewelry.

A source of frequent delight for one who walks through the summer fields with a small magnifying glass in his pocket is the study of such eggs. They are as varied as



▲ BITTERSWEET supports these eggs of the Angular-winged Katydid

snowflakes, as colorful as rainbows. And each new cluster of leaves promises a fresh surprise. On a clematis leaf, I once noticed a clump of small dark specks. Under my lens they expanded into burnished jewels, each egg seemingly plated with gold and ringed around the top with a series of little spikes like the crown of the Statue of Liberty. These spikes were also plated with insect gold. The following day I looked at them again. The gold was gone. All the yellow had faded away, and now the eggs were shining silver. On another occasion, small eggs deposited on a pine cone expanded beneath my glass into spheres with caps of brilliant scarlet circled with rings of golden dots, below which the egg was the richest shade of green.

Other insect eggs resemble lollipops, commas, pearls, sugar loaves, artificial eyes, minute tenpins, and Lilliputian beer barrels complete with hoops and bungs. The Hemiptera, the true bugs, produce the oddest eggs of all. Above each one deposited by one species of Hemiptera there unfolds a kind of straw hat or parasol.

The biggest insect egg I have encountered is, I believe, that of

the Polyphemus moth, one of the largest of the great silk moths of North America. Which insect produces the smallest egg I do not know. But it is probably a race between the minute fungus beetle, *Nanosella fungi*, a creature only a hundredth of an inch in length, and one of the fairy flies, the parasitic Mymaridae, some of which are so infinitesimally small that it would take more than 100,000 of them to weigh as much as a honeybee.

These minute creatures, some even less than a hundredth of an inch from head to tail, are egg parasites. That is, they lay their eggs inside the eggs of other insects, and their hatching larvae feed on the contents of the parasitized egg. Some of the fairy flies specialize in finding the eggs of back swimmers secreted in the underwater stems of aquatic plants. Swimming rapidly with their wings, they descend to depths hundreds of times their length to lay their eggs in the Notonectidae.

Many of the other small Chalcid flies are also egg parasites. In one case, 20 of the parasites came from a single butterfly egg. So short is the life cycle of some of these insects that several generations will



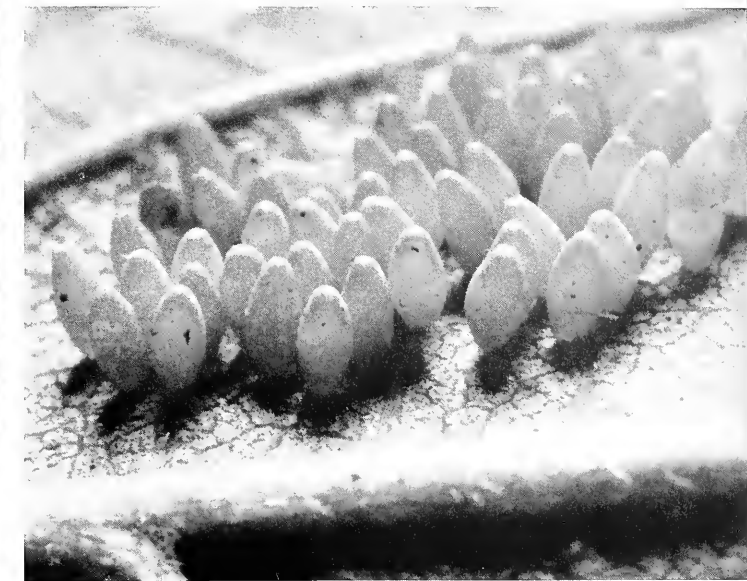


▲ FEMALE tussock moth beside her eggs, which are partially covered with froth. In their markings, the eggs suggest small artificial eyes

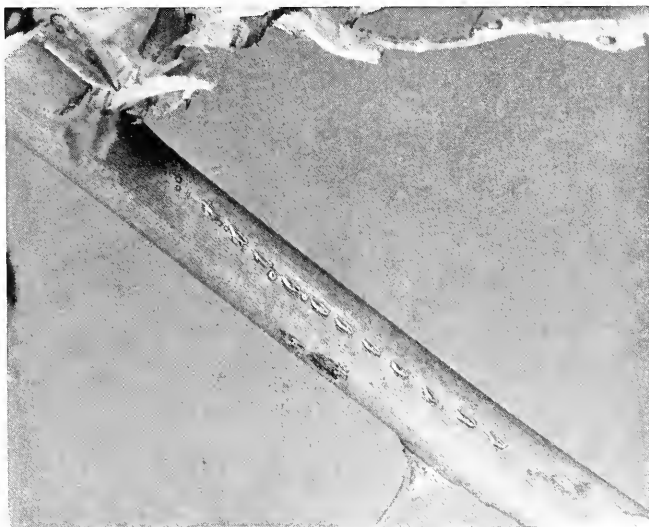
appear during the two-month egg period of the cicada. I know of nothing that reveals more dramatically the strangeness of insect eggs than the fact that several Chalcid larvae sometimes live and feed in the same egg of an asparagus beetle, and yet, in spite of this, the egg hatches and the young beetle appears.

When the egg of an insect is laid, it is enclosed usually in two envelopes—the outer shell and a delicate inner membrane. The shell itself is formed of a double layer. The thicker main shell of the egg is coated on the outside with a thin varnish-like covering. Eggs that overwinter seem to have thicker, harder shells, as a rule, than those that hatch in a few days during the months of hot weather. Insect eggs are sometimes found unharmed on dried plants that have been pressed for herbarium specimens.

If they are laid in moist surroundings, insect eggs tend to absorb water through their shells. In a number of instances, eggs have remained dormant for months when their surroundings became too dry to supply the needed moisture. In *The Principles of Insect Physiology*, V. B. Wigglesworth cites an extreme example—a South African locust, *Locusta pardalina*. Normally, in moist soil, the eggs of this grass-



▲ EGGS of the Mexican bean beetle on a bean leaf



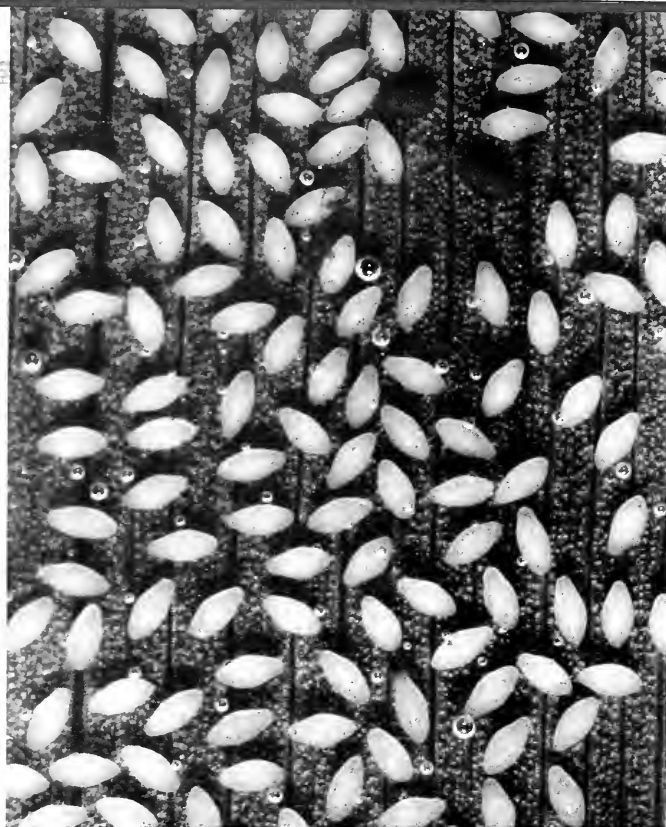
▲ PUNCTURES in a rose shoot left by a membracid in depositing her eggs

hopper hatch in about two weeks. When kept in dry surroundings, they have remained dormant for as long as three and a half years and then have brought forth baby grasshoppers when they were moistened once more.

During recent experiments with DDT, the protective function of the eggshell was shown in tests

with Japanese beetles. The poison failed to affect the forming insect within the egg. But as soon as the grub hatched and came in contact with the DDT on the outside of the shell, it showed the characteristic spasmodic twitching produced by the insecticide.

When hatching time arrives, one of several methods may be used by



▲ DRAGONFLY EGGS, laid in the water and lying on a sweet flagleaf, which was submerged an inch or so beneath the surface



▲ MONARCH BUTTERFLY EGG attached to the underside of a milkweed leaf

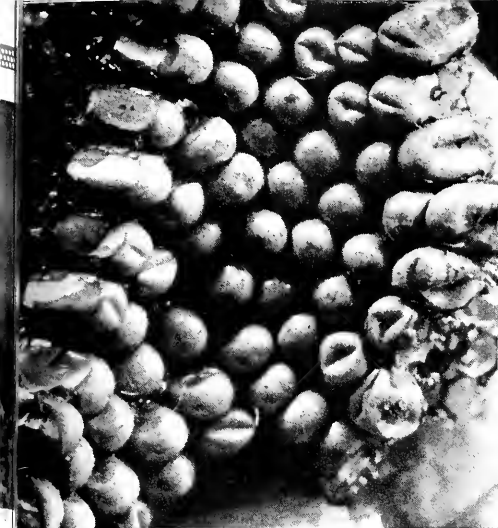
the insect to escape from the shell that encloses it. If it is a monarch caterpillar, it simply eats its way out of the egg and then dines on the rest of the shell. If it is the embryo of a flea, it uses a knifelike egg-opener that it carries on top of its head. If it is a Colorado potato beetle, it employs hatching spines, or egg-busters, to cut its way through the shell. If it is a giant water bug, it simply forces up a cap at the free end of its egg. Similarly, among the stink bugs lines of weakness in the shells provide caps that can be pushed up when hatching time arrives.

Where the baby insect finds itself when it issues from the shell is determined by the placing of the egg. Cabbage butterflies deposit their eggs only on cabbage and related plants. The Great Spangled Fritillary seeks out violets, and nothing but violets, when it begins laying. Mosquito eggs are usually placed in floating rafts on stagnant water. The alder fly deposits as many as 500 eggs in a mass on leaves or stones overhanging rapid streams so the hatching larvae will drop into the water below. Parasitic ichneumon flies insert their eggs into the bodies of caterpillars. And syrphus flies, whose larvae consume plant lice, often leave their eggs in the midst of the aphides on infested plants.

Walking stick insects scatter their



▲ THE CICADA lays its eggs in twigs. The pencil point indicates the places where the chisel-like ovipositor of the female has entered



▲ TENT CATERPILLAR EGGS as seen from the inside of the cluster, which encircles a twig like a bracelet

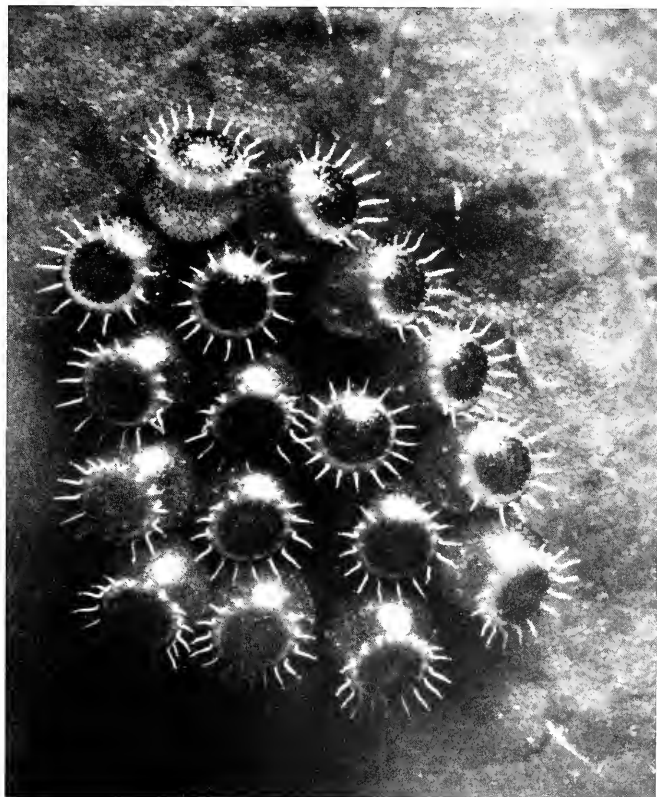
eggs carelessly, letting them drop at random among leaves under the trees on which they feed. The clear-wing moth, *Memythrus polistiformis*, often mistaken for a *Polistes* paper-making wasp, also appears to lay its brownish eggs haphazardly. But it has been noted that it always scatters them over vegetation near grapevines. Rains wash the eggs to the ground, where the hatching larvae are near the grape roots on which they feed. In various, often ingenious ways, the female insect prepares for the welfare of children she will never see.

In a bundle of shingles that had been stored all summer in a shed, a carpenter friend of mine once found a curious object several inches long. It looked, at first glance, like a piece of rough green-brown tubing. It was formed of small discs cut from leaves and fitted together into thimble-shaped cups stacked together to make the object he brought me. The cups were the cells of the leaf-cutting bee, *Megachile brevis*. Each held an egg and a small store of food for the larva that would hatch from it. Hundreds of tiny pieces of leaves had gone into the making of this apartment house for the children of the wild bee.

By walling off their tunnels into little compartments, the carpenter bees, living in sumac and elder branches and even in the solid wood



▲ Eggs of the Colorado Potato Beetle



▲ Eggs of one of the stink bugs

of buildings, produce similar provisioned rooms for their offspring. Mud daubers and the other mason wasps, including the maker of little jugs, the potter insect, *Eumenes fraternus*, store their chambers with paralyzed insects or spiders. Dr. Alexander Wetmore, head of the Smithsonian Institution in Washington, D. C., once told me of finding a mud dauber's nest that contained nothing but black widow spiders.

The masonry produced by wasps to protect the egg and the stored-up food is often surprisingly hard and resistant to erosion. In the woods I once came upon a solid yellow mass cemented around a twig. It was the product of a mason wasp. To test its imperviousness to rains, I brought it home and placed it in a glass of water. There, while I replenished the water that evapo-

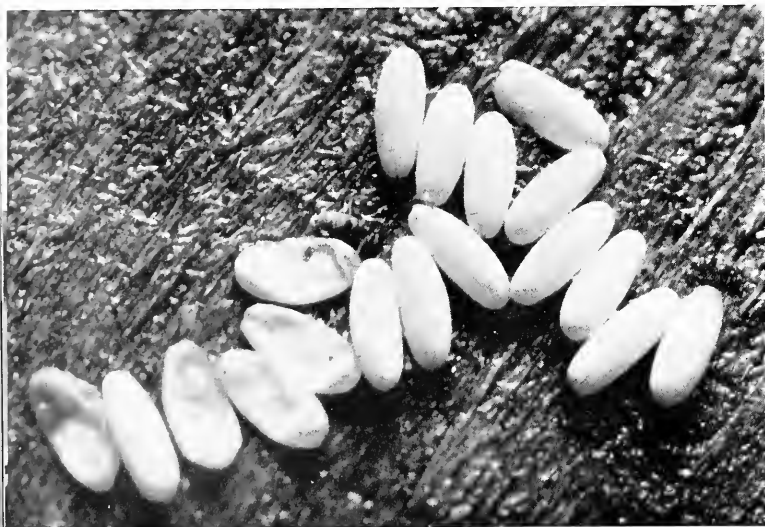
rated away, it remained day after day, week after week. At the end of more than 41 days—1002 hours—I took the twig out of the water and examined the wasp-made masonry. It was still hard. The water had penetrated only a little way beneath the surface. The larva within was dry and unaffected by the long submersion.

Many forms of containers house the eggs before they hatch. They range from the hardened froth mass of the praying mantis and the waterproof case of the *Hydrophilis* beetle to the gall swellings on goldenrod stems and the pine-cone-shaped bags of the bagworm, holding within the chrysalis shell the close-packed eggs. The eggs of the cockroach are deposited in dark little containers that suggest tiny cigar cases and which split open along the edge when the young

cockroaches hatch out. And the shard-borne beetle of the poets, the scarab, the familiar tumblebug of pasture fields, provides both shelter and food for its larva when it shapes the ball of dung it rolls along.

One winter some bittersweet that had been brought in from the woods remained on the mantel of my fireplace for several days before I noticed that along one of the curving stems there ran a row of overlapping oval objects—the eggs of an angular-winged katydid. Cemented there on a support of almost the same color, they were well camouflaged. In other ways, too, insects make their eggs inconspicuous. The most remarkable instance of the kind is the action of the female bark lice of the family Psocidae. After one of these insects has deposited her egg, she bites off a bit of bark and chews it into a kind of paste which she spreads over the egg, thus making it virtually invisible amid its surroundings.

It is in connection with the placing and the protection of the egg that some of the most dramatic instances of the wisdom of instinct among insects are to be found. Instinctively, the female *Meloe* oil beetle lays her eggs near or on flowers that are visited by wild bees, thus enabling her larvae to attach themselves to these winged insects and be carried to the nests, where they will live as parasites. Instinctively, the females of some of the hairy, bumblebee-like flies known as Bombyliidae, whose larvae feed on the eggs of bees and wasps, hover before the entrance



▲ FROM these eggs of the fly *Eristalis tenax* hatch the rat-tailed maggots that live underwater and breathe through their tube-tails

➤ OVIPOSITOR of a grasshopper with an egg at the end. This egg-planter is used for inserting the eggs into the ground





◀ A *POLISTES* paper-making wasp beside the first cell of the flat nest. This cell contains the first egg laid by the overwintering queen

▼ CLOSE-UP of the nest as it appears later, with the eggs in the cells in the lower portion of the photograph, larvae in cells above, and the covered-over cells, in which the transformation into adults is made, appearing on top. Adjacent to these are the empty central cells from which adults have already emerged



of nests and flip their eggs inside. Instinctively, the digger wasp engages in an involved sequence of actions to provide food and shelter for its larva.

But instinct sometimes goes astray. In my backyard I once found a cluster of Lepidoptera eggs running along the side of a clothesline. The rope, round and slender like a twig, had attracted the attention of some small moth. On another occasion, a heavy guy wire, about three-eighths of an inch thick, was decorated with delicately striated eggs that hatched and produced minute inchworms. They were the larvae of a Geometrid moth. In both instances, instincts that were functioning for millions of years before ropes and wires came into existence had led the female moths to place their eggs on these barren but twiglike supports. However, Nature allows for many mistakes and many failures, for the destruction of countless eggs and the death of an incalculable number of young.

I once counted slightly more than 200 praying mantis egg cases in an overgrown plot only 70 paces wide and 100 paces long. Each of them held from 125 to 350 eggs, the average being about 250. Thus, when spring came, something like 50,000 young praying mantises

would appear in this relatively small area. Yet, as one female often makes two or more egg cases, there probably had been fewer than 100 pairs of mantises in the area in the fall. If this were true—if there were 50,000 individuals at the beginning of the season and only 200 at the end—the survival chances of the individual would be about 1 in 250, or less than one-half of one per cent.

In many other species the mortality is even greater. However, throughout the insect world the

rule seems to hold that the greater the risk and the greater the chances of not reaching maturity, the larger the number of eggs the female lays. A study of these eggs, a study of all the strangely formed and strangely placed eggs of the insects, is a field that is open to everyone. Few people have collected insect eggs. Few scientists have specialized in this study. Entomological oölogy is still in a pioneer stage, still a promising and fascinating field of research for professional and amateur alike.



➤ EACH FEMALE lays but a single white egg. One parent incubates the egg while the other scans the water for food

By  
LEWIS W. WALKER  
*All photographs by the author*

# PETRELS

## OF CARDONOSA

In tens of thousands they move shoreward  
at dusk and bring life to a barren island



THE island called Cardonosa by the Mexicans is far from the beaten track, and weeks and months often pass when it is not even sighted by the few fishing boats that ply their trade in the Gulf of California. During the daylight hours, it is similar to the other barren, colorless islands of the Gulf. But with the coming of dusk, it is transformed into a fairyland populated by incredible numbers of Least Petrels, the smallest cousins of the giant Albatross.

Soon after the sun has slipped below distant Los Animas Point, on the Peninsula of Lower California, queer noises are heard under the island's rocks, which extend inland beyond the high-tide mark. At first the noises are infre-

◀ CARDONOSA ISLAND, desolate during the day, becomes a popular night spot for incredible numbers of chattering Least Petrels





quent, but as the afterglow fades into darkness and the belt of birds at sea moves shoreward—over the beach, over the tide marks, and onto the jumbled boulders—the sounds swell to tremendous proportions. Tens of thousands of bird voices ring from the miles of rocks that cover the island and blend into a repetitious melody which is harsh yet pleasing.

The Least Petrel is a solitary bird, winging its erratic course over the water's surface. During February or early March, however, the birds seem to pair off for courtship, and by mid-April they start to choose nesting sites for a honeymoon of over a month's duration. During this period, I have found them huddled together in smelly crevices—an abode, perhaps, which only true love could endure. The laying of a single white egg ends this close association, and thereafter only one parent occupies the nest during the day.

The mate that is freed from the duties of incubation flies far out on the Gulf in search of small organisms on the water's surface, and often a half-mile flight is necessary to procure a pinhead of food. Sometimes, however, there will be a concentration of food in one small area, and to these spots the petrels swarm like vultures to a carcass. If the food is surface-borne, the petrels rarely settle on the water but prefer to grasp the food while pursuing their zigzag flight.

At times, because of temperature or current, the marine life upon which they feed forms a blanket eight or ten inches below the surface. The petrels will then alight on the water and observe the food below. Some of them will rise a foot or more in the air and dive, beak first. In this manner a few are able to submerge their bodies, although the black wing tips usually remain above the surface.

These bits of minute plankton picked from the water must be very rich in oil, for when the birds return to the island by nightfall, all the food taken in during the previous hours has changed to an oily substance. Satisfying hunger is not its only use, however. When a petrel is forcibly removed from the nest, it discharges this secretion through the open beak and perhaps through the tubular nostrils. The liquid squirts out in an explosive

stream, and if it touches the clothing, the distinctive petrel odor will linger for days.

When the eggs start to hatch in late June, the offspring emerge as gray balls of fluffy down, absurdly round and helpless. From frequent visits to the island, I judge that their growth is rapid. Within a week after hatching, they are capable of squirting their second-hand oil with all the skill and accuracy of their parents.



➤ A GRAY BALL of fluffy down, the newborn petrel rests helplessly in the rocky crevice for several weeks

► LOCATED near the center of Florida in a 1050-acre tract with easy access to a wide variety of life zones, the Archbold Biological Station provides modern and efficient laboratory facilities for research in many fields of natural science



## The ARCHBOLD BIOLOGICAL STATION

BETWEEN 1928 and 1939, the public occasionally had opportunity to read newspaper accounts of the explorations of Richard Archbold, a quiet man who wanted to discover new things about our old world and went about doing it efficiently and thoroughly. As Research Associate at the American Museum, he collected mammals in Madagascar and conducted three expeditions in the unknown interior of New Guinea, traveling in what was for that day a sort of Space Ship.\*

During this time, a thousand acres in south-central Florida were developed into a private estate by Helen Price Roebling. There was no connection between these two activities until the spring of 1941. Richard Archbold did not even know the property existed, much less that it would be possible for

A strange combination of circumstances led to the creation of this outstanding science center in Florida's flatlands, where specialists gather to pursue their individual inquiries into the world of Nature

By FRANK A. RINALD

*Archbold Expedition Photos*

him to acquire it. The tale of how it became the Archbold Biological Station is one that exposes the narrator to accusations of stretching the long arm of coincidence. Philanthropy, a chance meeting, and the bond of a common interest were uniquely involved. But the deciding factor was one that is essential to the establishment of a biological field station anywhere—its geographical setting.

The property was situated in open country at the southern end of Florida's hilly lake region, about midway between the Atlantic and the Gulf of Mexico. As the peninsula is nowhere more than 200 miles across, both coasts were only a

short distance by car. The location offered easy access to five of southern Florida's physiographic regions. Thus it was especially well suited to research in terrestrial and freshwater biology. And in the coastal regions, the mangrove swamps and salt-water marshes offered a variety of quite different studies, particularly in the Ten Thousand Islands where wildlife was abundant. Here one could find large rookeries of brown pelicans and colonies of beautiful long-legged herons.

In 1940, the nonprofit scientific corporation known as the Archbold Expeditions, through which Richard Archbold's various exploratory trips had been financed and con-

\*Readers of NATURAL HISTORY will recall detailed accounts of these explorations in "With Plane and Radio in Stone Age New Guinea" (October, 1937), "Flying Birdmen" (October, 1940), "Latchkey to a Savage Tribe" (April, 1941), "Papuan I Have Known" (February, 1943), and other articles.

ducted, found itself on home territory with trained personnel, tons of equipment, and plans for a fourth expedition to New Guinea. This was to be the last of a series of comprehensive biological explorations of that island. But war was brewing in the Far East, and the plan had to be shelved.

Richard Archbold established a temporary base in the southwestern deserts near Tucson, Arizona, and carried out studies on the life history and behavior of birds and mammals, as well as field experiments in Kodachrome motion pictures with sound. Here the idea of setting up a permanent biological station somewhere in the United States was born. But the capital outlay seemed prohibitive, and the thought was wistfully abandoned.

Then Richard Archbold chanced to meet a boyhood friend. Donald Roebbling told him of the property his mother had developed just before she died. Would he be interested in it? There was a power plant, a good water system with a 75,000-gallon storage tank, fire-fighting apparatus, carpenter and machine shops, and a garage equipped for service and repairs. The warehouses could be converted to a variety of uses, and there were living quarters. All the buildings were of steel and concrete, completely fireproof and designed to withstand winds of hurricane force and to endure practically forever. The buildings, on low ground near the railroad line, were connected with the hill section by a hard-surfaced road. Clay roads and firebreaks had

been strategically laid with as little disturbance to the vegetation as possible.

Donald Roebbling's mother had been a student of botany and had wanted a home in a natural setting where she could gather about herself flowers and plants and trees native to the region. The family wanted to dispose of the property but only to someone sensitive to the unspoiled beauty of the land. Donald Roebbling thought that its use as a biological station would especially have pleased his mother. Why not go to Florida and have a look at it?

Richard Archbold did, and when he returned, impressed with the possibilities of the establishment and its surroundings, Mr. John A. Roebbling arranged for the transfer of the property to Archbold Expeditions, free of all encumbrances for the legal consideration of one dollar.

Just when the Station became a "going concern" is a bit difficult to say. Many things had to be done at the beginning. The warehouses were soon fitted out to include an office, stockroom, biological laboratories, library, sound movie studio with auditorium, chemistry lab, and



▲ EXPLORATIONS AFIELD:  
Camp pitched between a pine-tree palmetto flat and a cypress head on the edge of the Fathahatchee Swamp, a section of the Big Cypress

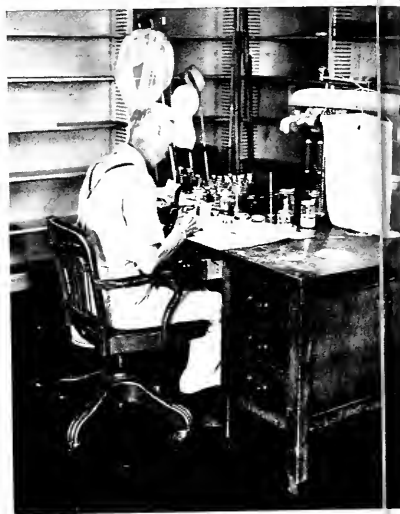


► NEAR DINNERTIME,  
Richard Archbold tests a  
stew



◀ DR. JAMES C. NEEDHAM, Professor Emeritus of Cornell University, dredging the shallow bank of a stream for dragonfly nymphs

▼ AT HIS DESK in the laboratory, where Dr. Needham identified more than 60 species of dragonflies from the Station area over a three-month period



photographic darkroom. The living quarters were expanded, and small cottages were erected. Accommodations were provided for visiting workers, for the Station is intended to serve students in any field of zoological, botanical, or anthropological research at the approval of the Advisory Board. There are accommodations at present for ten visiting workers, who pay a nominal fee to cover living and other expenses, unless they are staff mem-

bers of the American Museum of Natural History with which the Station is affiliated.

With the purpose of outlining a comprehensive research program, the scientific staff explored the region in books and on foot. The so-called Highlands Ridge, on which the Station is located, reaches only a short distance into southern Florida. Seven miles south of the Station it disappears entirely. From there, about 13 miles to the south-

east, the Everglades begin: a vast, soggy spread of saw grass marshes, wet prairies, bayberry thickets, and occasional oasis-like hammocks and tree islands.

To the west of this stretch are 1200 square miles of swamp and forest known as the Big Cypress, parts of which are as wild as they were a thousand years ago. Drainage projects, fires, and excessive hunting have been forcing many animals deeper and deeper into the wilderness. The Everglades and the Big Cypress still provide living space for native animals such as the Florida bear, deer, panther, otter, turkey, and alligator. Closer to the Station the country is perhaps less



◀ THE AUTHOR making a note on a botanical specimen in the library, with the herbarium opened before him

NATURAL HISTORY, MAY, 1948

spectacular but more interesting in its variety. Sandy stretches of palmetto, scrub oak, and spruce pine cover the "highlands." The ridge flattens out on either flank to broad prairie lands of wiry grass, where the vegetation is affected in a remarkable way by slight elevations. Sometimes a rise of only a few inches produces a cabbage palm hammock—an island of dusty-green, mop-topped trees on slim gray trunks—or a sociable colony of palms, oaks, and shrubs. Occasionally a lone pine or palm survives as a remnant of hammock growth in open prairie. Level stretches of sandy soil, dry except in the rainy season, support acres of tall, straight pine trees. A low place may produce a soft bottom of brown water and muck and fern which supports, in a tangle of wild grapevine and bamboo briar, a dense stand of white bay trees, whose crowns are dappled with silver when the sun glints on the gray underside of breeze-riffled leaves. A sharper dip in the ground may create a cypress swamp, dark and stately, with brown knees pushing up out of the water and gnarled branches trailing shaggy streamers of Spanish Moss.

These frequent and abrupt variations affect the distribution of ani-

► A PAIR OF AMERICAN OS-  
PREYS, or Fish Hawks, looking  
out on the world from their  
bulky, moss-bedecked nest. The  
nest of this bird is sometimes  
3½ feet in diameter and 2½  
feet high



mal life, so that one need go no considerable distance to find two kinds of animals with widely different ways of living, like the little owl that digs its burrow in dry prairie and the water turkey that fashions its nest in a tree beside a slough.

The lakes, ponds, marshes, and streams which virtually surround the property are part of the water lane that runs the full length of peninsular Florida. They provide excellent places for the study of fresh-water biology and the migration of birds along their natural pathway to and from the tropics.

Because the main gate on the country road that intersects the property has always remained open, travelers—at least those who favor the less frequented highways—often drive in. And they are welcome. Sometimes there are things of special interest for them to see. One day two visitors had the opportunity of looking through a microscope at the fresh bloom of a tiny

wild orchid. They also saw dragonfly nymphs being reared in screen cages dipped in the lily pool, and watched a captive adult dragonfly being fed by hand.

The family of raccoons who live in outdoor cages do not quite rank as special attractions, because they have been with us for a long time and simply will not leave. But for a while, "Snorty" and his kin had as rather interesting neighbors two young American bald eagles who had tumbled from their nest when the upper branches of a falling pine swept the top of their tree near a lumber camp some distance north of the Station. The men who brought them reported that the birds, stunned and unable to fly, had been deserted by their parents. Would we look after them? The young were large, black, fearsome-looking creatures, timid and helpless as babies.

Then there were the favorites, Robby and John—two blue jays who lived in a small flying cage and were the principal participants in



◀ VISITORS to the Station find interest in the many wild pets under casual or serious observation, such as this Florida Scrub Jay. Not as vividly colored as his relative the Blue Jay but more aggressive and impudent, the Scrub Jay is an all-year resident and becomes as tame as a Central Park pigeon with the slightest encouragement





▲ A "SWAMP BUGGY" in the Big Cypress: a high-riding jalopy equipped with airplane tires in the rear, designed to penetrate the outer fringe of forest through the marshy places and narrow streams impassable to ordinary vehicles



▲ A SEMINOLE MOTHER and daughter strolling along a cypress-shaded road a few miles north of the Station. Mother's hat is her own hair carefully arranged over a wire frame. The Archbold Biological Station affords opportunities to study the native Indians of the region

◀ PERRY WILSON, distinguished artist, at his easel, sketching a wilderness scene for reproduction in full size in the American Museum in New York City. It will be used as the background for one of its celebrated habitat groups in North American Hall

an experiment on animal behavior. John learned in three days to pull up a tiny bucket containing food, which was suspended from the common perch by a string. He would take the string in his beak and tug. When he stopped to rest, he held the string fast with one foot. Sometimes it took four or five tugs to haul up the bucket. Robby, less enterprising, would watch the operation intently, hover when the container reached its goal, and greedily partake of the food. But in the month they were together, Robby never once shared in the labor of procuring the meal—nor did he ever go hungry. When John was removed from the cage, Robby had to provide for himself.

However, it was soon apparent that, though he had freely benefited from John's enterprise, he had not taken advantage of his educational opportunities. He secured the food in a different way. He flew to the swinging bucket and, in just the time he could flutter beside it, managed to scoop out a beakful. It was a clumsy way of getting the food, but he persisted in this method until the fourth day, when he suddenly learned to haul it up as John had done. Thereafter he continued to do it that way.

Other research projects carried out by the Station have included studies in the life history and be-



havior development of burrowing owls, dragonflies, ants, spiders, reptiles, the beach mouse, round-tailed muskrat, and spotted skunk. Research has been undertaken regarding the factors involved in color changes in the plumage of birds and the relationship of animals to their habitat in a subtropical environment both today and in the geologic past. At least one study did not make use of local products: the anatomy of the gorilla.

Several years ago an interesting laboratory experiment was carried out to test the behavior of some Formica ants. In the field, foraging ants had been seen to drop to the ground from grass blades or stems of bushes. Their ability to spring from elevated surfaces was clearly demonstrated during several attempts to capture the insects by hand. It appeared, too, that the Formica were guided on their long foraging routes by well-defined landmarks such as trees or groups of trees. Even if the ground was thoroughly disturbed, the ants could travel directly across an open area 12 yards wide among palmettos. But when a large black sheet was erected to hide a pine tree standing at one side of a distant nest, they became disoriented.

For the experiment, two nests complete with galleries, chambers, queens, workers, and brood were carefully dug from the sandy palmetto scrub and brought to the laboratory. An apparatus was constructed which made it impossible for the ants to reach food except by dropping to it from a point about ten inches above. At first their falls seemed accidental, as though they had lost their footing while running upside down on the glass ceiling. They toppled at random and as often as not landed far from the food.

After 30 or more trips their ability to hit the card on which the food was placed improved so much that misses decreased noticeably. It also

seemed that they dropped more readily and accurately when the card was of a sharply contrasting color. Thus vision, rather than some other sense, appeared to be involved.

The laboratory "shows" to which guests may be invited must be limited according to the type of experiment in progress and the convenience of the biologist; but when the laboratories are not accessible, it is counted a poor day if the resident wildlife does not provide the visitor with entertainment. The staff is proud to present a nestful of shrike fledglings in the rose vines on a fence near the office, a covey of quail that scurry light-footedly across the pavement of the plaza, a sand-hill crane rising from the neighboring flatwoods and giving its lusty *hololololo*, and an egret sitting like a snowy ornament in a tall pine tree near the aerating plant. Hunting is not permitted on the property, and the prevailing conceit is that the birds know it.

Conservation is one of the paramount interests of the Station. It collects no specimens of animals except those needed for specific

scientific purposes. It houses no general study collection. Preservation of natural riches is needed throughout the United States but nowhere more than in Florida. Man-made fires and excessive drainage of the soil have caused depredations to the land and its wildlife that are well known to conservationists. The slaughter of plumage birds for commercial purposes in the past is also a matter of general knowledge. But it is not so widely known that the Indian mounds, relics of the earliest known settlers, have until recently received no protection whatever. It was common practice among construction crews to level convenient mounds and use them for fill in road building. Amateur treasure hunters, seekers of gold coins and trinkets, still exercise an unwholesome predilection for despoiling mounds, and they count bone and pottery fragments as so much rubbish. Fortunately, their forces are dwindling. The Station concerns itself with matters such as these. It also cocks an anxious eye toward certain lumbering operations. For two years, on an average of twice a week, 40-car



► A VENERABLE CYPRESS  
hung with Spanish Moss on  
Lake Istokpoga



◀ FISH-EATIN' CREEK, at a sunlit spot, some 20 miles south of the Station—a quiet unspoiled stream bordered by water oaks and cypresses. Beneath the large oak at the bend is a deep, cool "speckle perch" hole

trains heavily loaded with cypress logs have passed the back door of the Station going north to a sawmill. The logs are cut in the Big Cypress, one of the last great stands of "wood eternal" in the United States.

The Station has also helped to bring the natural wonders of Florida to people who would never otherwise see them. An example is the habitat group showing a Florida black bear in its natural setting, which will soon be opened in the Hall of North American Mammals at the American Museum.

It proved quite difficult to procure the materials and the specimen for the construction of this group. In creating these exhibits, a trained preparator must, of course, collect samples of soil and tree trunks and make plaster impressions of leaves. Many photographs are taken, and the artist paints background sketches and matches his colors for ultimate reproduction of the scene in natural size.

► DR. FRANK A. HARTMAN of Ohio State University at work in the biology unit. He gathered data on the endocrine glands of birds

Two weeks of hunting far afield failed to produce the bear. Neighbors insisted that "It wa'n't no need to go so fur when there is b'ar in the Baygall." They referred to a large bay swamp, a State Reserve, a few miles from the Station. It had not seemed advisable to request permission to go in there. But now it transpired that the bears were boldly coming out to pillage commercial beehives, and they

had gamboled destructively in at least one valuable patch of Easter lilies. Moreover, they were frightening women and little children as well as, doubtless, a few men who did not care to admit it.

A hunt was organized with the co-operation of the game warden. A small pack of local "hawg" dogs was hastily recruited, and every man on the Station who could handle a gun joined the party. As bait, a tasty mixture of honey and alcohol with a side dish or two of nembatal tablets was set out on the banks of Boiling Springs, a small stream at the foot of a steep sandy incline on the edge of the Baygall. Evidently the bears enjoyed the refreshments: there were signs of revelry, and the pails and cans were found high on the hill or deep in the palmetto where the bears had flung them with happy abandon. But they were still wily. Animals were seen twice during the day, but they eluded their captors each time.

Early one morning when the moon was still high, a slim young neighbor named Cecil, who had





▲ A STRANGE WAY to get your supper: Buddy Cline "attacking" a young cabbage palm. Its heart, known as "swamp cabbage," is a delicacy prized by bears and humans. You cut a stem about two feet long, slit each outer layer lengthwise with a knife, and peel carefully until you reach a layer that is not bitter to the taste. The "heart of palm" is delicious raw in salad or boiled with fat bacon. It tastes faintly of nut and very young cabbage

lived on the edge of the Baygall all his life, went out on horseback to look for signs. He felt confident he could find a new bear trail, and he did—a large fresh one.

Later that morning he set out with another member of the party and two dogs on leash. The dogs quickly picked up the scent. The rest of the party were given about 20 minutes to take strategic positions. Cecil and his companion, Buddy, slow-trailed into a broad boggy patch of palmetto taller than themselves. It was difficult to step

from root to root to avoid sloshing into the soft mud. Briars pulled at their clothing and scratched them. After about a quarter-mile of this the dogs were straining frantically at their leashes, and they were turned loose.

A movement of the palmetto tops 200 yards ahead showed that the dogs had found the bear. The wind favored the men on the east stand, so they heard the sudden barking. They also heard Buddy's shout, but he could not hear their answering cries. Cecil ran north, hoping to head off the bear if it should run for a finger of bay-tree swamp jutting into the palmetto patch. Buddy alone followed the dogs as best he could—running, slipping, tripping, and, as he explained later, "not too durned eager."

The bear led the dogs south; then it back-tracked north. Cecil, having sprinted the full length of the finger and across it, was returning through it when, guided by the noisy dogs, he saw the bear treed at the edge of the swamp.

He shot three times, and the bear slid down and came within ten yards of him. The main party was now coming in on the double,

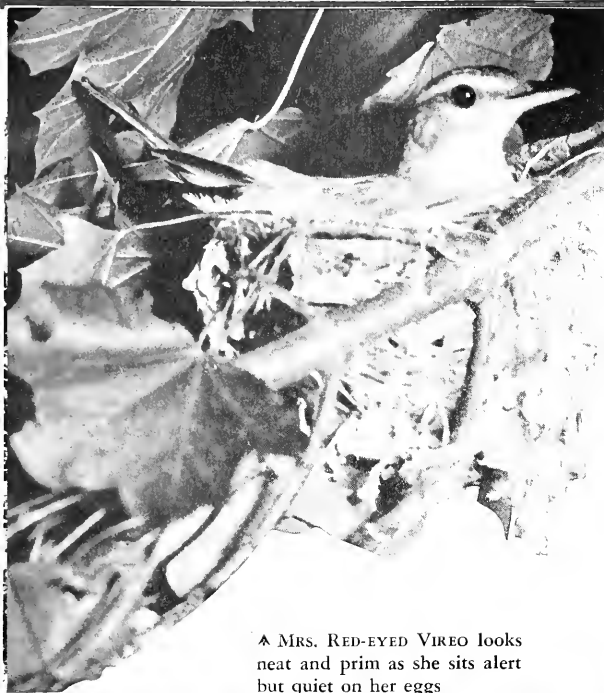
but swift action was necessary. Cecil shot twice more, and the bear dropped dead.

To the preparator's relief, it fell in the shade where it could be measured and worked on with a minimum of deterioration. It weighed 410 pounds, less than the 600-pound estimate, but was a handsome male, nevertheless, with a thick glossy pelt.

The excitement of the hunt is a rare experience at the Station. It is generally occupied with more peaceful pursuits. It has a distinctive atmosphere compounded of its history, the people who work there, the ideas that are developed, and the surrounding wildlife and countryside. In the cool of the evening, the setting sun fills the sky with rich color. Against this backdrop, night jars dive a hundred feet straight down to catch insects, hauling up with a rushing thump of their wings the moment before they might dash themselves to the ground. In the spring, the nightly frog chorus thrums a great barbaric symphony that resounds over the flatlands. And on a still night during the full moon, a mockingbird may sing.



► A CENTRAL FLORIDA SILHOUETTE that could be almost anywhere south of the Caloosahatchee River



# A *Vireo* AND HER NEST OF YOUNG

By LYWOOD CHACE

▲ MRS. RED-EYED VIREO looks neat and prim as she sits alert but quiet on her eggs

▼ A DRAGONFLY FOR LUNCH. Now that the young Red-eyed Vireos have hatched, they keep Mother Vireo busy from dawn to dusk keeping their ever-hungry mouths filled with food





▲ IT'S NO EASY MATTER TO tuck a dragonfly down the throat of her youngster, but Mother Vireo is determined to put it where it will do the most good



► NOW THAT DARKNESS is settling down on the woodland, Mother Vireo places her body over her brood to keep their nearly naked bodies warm during the cool night





## a Methuselah among trees

The gigantic Tule Cypress, near Oaxaca, Mexico, is one of the most famous trees in the world. Its trunk is 52 feet in diameter, and its age is lost in the mists of antiquity

By WALTER HENRICKS HODGE

*All photographs by the author*

**I**N human reckoning 5000 years is a long time. It encompasses most of what we call the high lights of civilization, for 5000 years ago—approximately the year 3000 B.C.—western civilizations were in their infancy in the cradles of Mesopo-

tamia and Egypt. In those areas and at that time the Stone Age had just been supplanted by the Age of Bronze; the first empire of the Babylonians was 1000 years in the future; the singing of the Iliad was almost 2000 years distant; and the birth

▲ THE TULE CYPRESS grows in the churchyard of the village of Santa María de Tule in Southern Mexico. Its luxuriant verdure shows no signs of decay

of a man called Jesus was 3000 years ahead. To jump from 3000 B.C. to our incipient age of atomic energy in the middle of the twentieth century covers more than 200 human generations, yet the same time represents, according to some estimates, the life span (and an uncompleted one at that) of a single Mexican cypress tree, the famous tree of Santa María de Tule.

Whether its age is 5000 years or less, the ripening cones of a cypress tree open on some long-forgotten day in a mile-high valley now

NATURAL HISTORY, MAY, 1948



known as the Oaxaca Valley, 250 miles southeast of present-day Mexico City. One of the innumerable tiny seeds fell to the ground, thrust out its hypocotyl in germination, took root, and started its evergreen existence. That seedling matured, forming a tree which has been living ever since. Although it has reached a height of only 150 feet, it has managed to increase its greatest diameter to 52 feet, a thickness probably attained by no other living tree. The surprising thing is that the Tule Cypress shows no sign, aside from size and aged grandeur, of its antiquity. Its crown is beautifully symmetrical, more so than those of many a younger cypress, and what is more remarkable, the Tree of Tule appears as healthy as it must have been in early youth. Not a single dead twig is visible in all its lush-green, pendant, yewlike foliage.

Because of its size, the Tule Tree has been called, by at least one distinguished botanical authority, "perhaps the most remarkable tree in the world." The aged giant is a gymnosperm, like our familiar pines, spruces, and firs, and belongs to the genus *Taxodium*, the same genus to which the American or Bald Cypressess of our southern swamps are assigned. Technically the name of the Tule Tree is

*Taxodium mucronatum*, but the species is more familiarly known in English as the Montezuma Cypress, after the famous Aztec emperor who was conquered by Cortez. The Aztecs themselves called the tree *ahuchete*, a name still used today, but as might be expected in a land

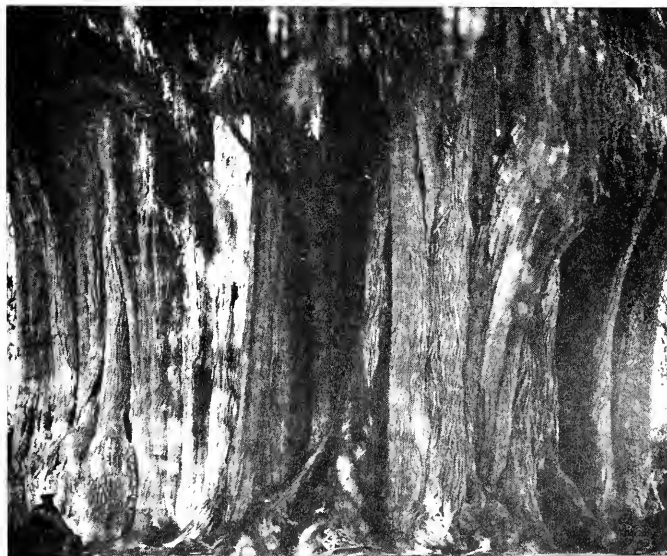
where native idioms are numerous, a half-dozen other names of Spanish and Indian derivation are also heard, including *pentamu cipres*, *cipreso*, *sabino*, and *tnuyucu*.

The giant sequoias and redwoods of California are first cousins of the Montezuma Cypress and are



▲ ZAPOTEC GIRLS selling fruit in the shade of the giant tree

▼ THE TRUNK is so large that 28 persons touching fingers can barely encircle it. It is possible that three trees may have fused to form this massive column



▲ CLOSE RELATIVES of the Montezuma Cypress: Bald Cypressess growing in a southern swamp in the United States



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also its only close competitors as far as age goes. Based on actual ring count, the oldest sequoia is 4000 years old. The straight boles of the redwoods and sequoias, like many another tall-growing tree, far overtop the tree of Oaxaca, whose height is only 150 feet; but they cannot match its 52-foot diameter. This diameter is 14 feet greater than that of the General Sherman tree, the largest sequoia. The circumference of the Tule Tree is such that 28 persons touching fingers can barely encircle it.

Although the trunk of the cypress is at present a continuous, single one, it is possible that the tree is not a single individual but rather a composite of several close-growing trees whose trunks, through the many centuries, have become completely fused. This impression is gained if one climbs up into the lower branches and looks into the central portion of the cypress. If this is so, the Tule Cypress would be doing something typical of its race, for the Bald Cyresses of our southern swamps often grow so closely as to become partly joined. The tree rings of this giant tree have never been counted, so there is no precise way of knowing its age. Increment borings, a standard forestry technique, cannot be made on such a large tree. If the trunk is in reality three trunks, the age is probably considerably less than the maximum estimated.

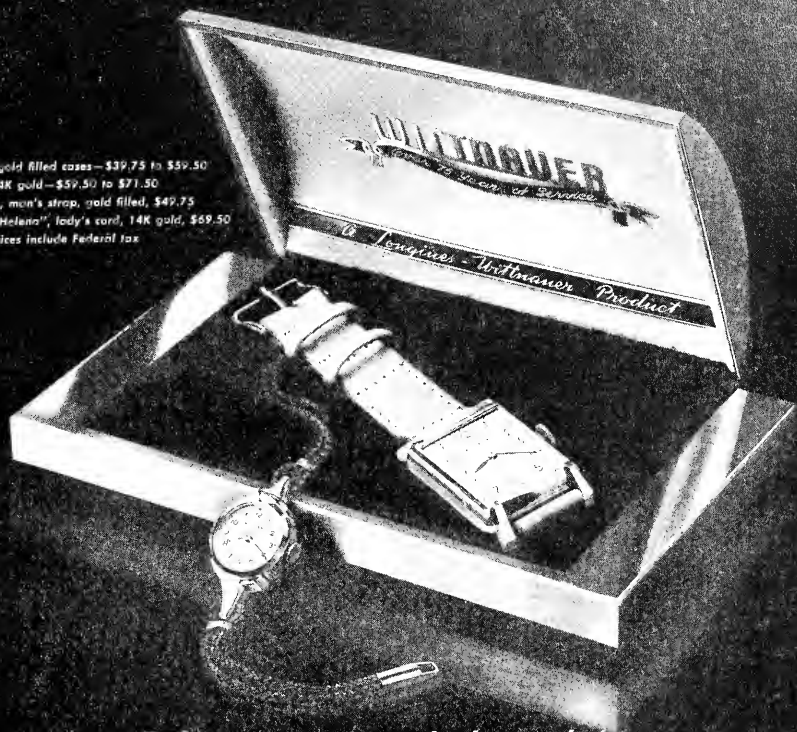
Montezuma Cyresses range throughout a number of the high-land valleys of Mexico from Sinaloa and Coahuila southward on wet sites which originally were marshes or swamplands. Where they occur in standing water, the roots of the tree send up characteristic breathing knees like the Bald Cyresses which are also inhabitants of areas periodically inundated. It is well known that Mexico City, where a number of famous Montezuma Cyresses still grow, was originally an island city, a Venice of the New World, surrounded by lakes and marshes and only reached by boat or by mile-long causeways. Groves of giant cyresses were common in those days and so impressed the

conquerors that frequent mention is made of them in their chronicles. Certain of the trees mentioned, like the groves in the suburbs near the royal hills, or *lomos*, of Chapultepec, may still be seen, even though the lakes have long since been filled in. Other groves or single great trees that were mentioned as venerable giants over 400 years ago still live on in full vigor. Thus midway on the route between Vera Cruz and Mexico City in the town of Tlatlauquitepec there is an old Montezuma Cypress to which Cortez is said to have tied his horse. This is possibly the first individual of the genus *Taxodium* seen by a European. Most famous of all the trees in the Valley of Mexico is the gnarled giant at the village of Popotla (now called Popatela), originally located on the margin of the lake surrounding Mexico City, at the terminus of the main west causeway running out of the capital. Over this causeway passed the awful retreat of Cortez and his men on the bloody night when, following the death of Montezuma, the Mexicans beat back the Spaniards from their capital. That was a sad night indeed for the defeated Cortez who, tradition says, rested under Popotla's old cypress tree. To this day it bears the name of that night that was so sad to the would-be conquerors — "*Arbol de la Noche Triste*."

The ancient Mexicans of pre-conquest days were noted as gardeners and landscape architects, and it would appear from the location of a number of the Montezuma Cyresses, at least in the Valley of Mexico, that they might have been planted as ornamentals. Besides this use, the acrid resin of the tree was widely known and used medicinally by the Aztecs for the cure of a number of infirmities ranging from ulcers and skin diseases to toothache and gout. Other Aztec medicinal were also obtained from the cones, the shredded brownish-red bark, and from the wood. The latter, though soft and weak, takes a good polish and finds use even today in cabinet work or in general construction. Obviously it is not

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for such homely uses that the old cypresses of Mexico will be always and justly noted but rather for their great age and girth, as shown in the ancient patriarch of Oaxaca. If any living thing is nearly eternal on earth it is this tree of Santa Maria de Tule.

## "SCORPION" OF THE TREETOPS

*Continued from page 215*

take of considering the redheaded variety different from the striped female. Later, the greater five-lined skink lost its identity through confusion with the common five-lined skink (*Eumeces fasciatus*). Finally, in 1932, Dr. Edward H. Taylor, who had studied this group extensively, yanked it out of obscurity. This caused a certain amount of scientific furor, and some herpetologists refused to recognize a difference between the two creatures. Today the greater five-lined skink, *Eumeces laticeps*, is acknowledged to be a different species from its smaller brethren, the common five-lined skink and the Floridian five-lined skink, *Eumeces inexpectatus*. The latter, it is interesting to note, was discovered as late as 1932, when the area was supposed to be finished so far as new reptiles were concerned.

Although its remarkable speed and shy habits may preserve the greater five-lined skink from ruthless extermination, the real threat to it is through the wanton exploitation of the forests where it lives. The destruction of this animal would be no real loss to humanity, but along with it, many characteristic birds, mammals, and wild flowers, the heritage of American conservation, would also perish. As one of our most splendid reptiles, despite its ugly appearance, the redheaded "scorpion" of the treetops is almost as much a part of the American tradition as the rattlesnake and copperhead. If we must have a justification for its protection, its insectivorous habits, beneficial to agriculture in a small way, are sufficient. In its role as "scorpion" it is harmless enough; but perhaps its formidable reputation will continue, for scary tales about the creatures of the woods die hard.



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*June*

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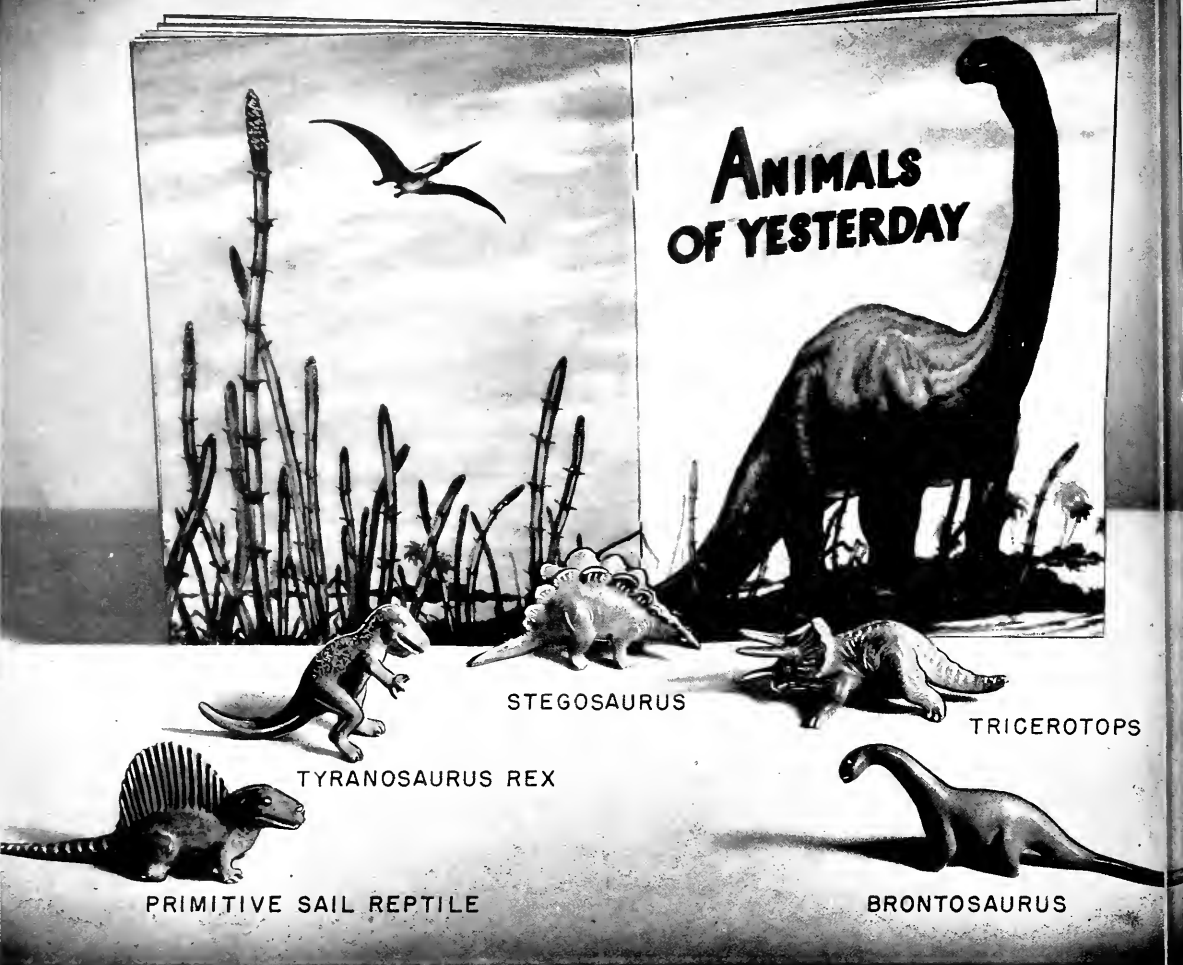
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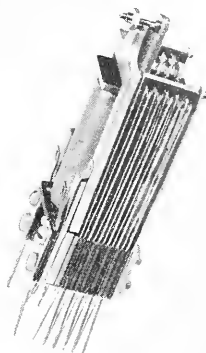
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# LETTERS

## *Grunion and the Moon*

Readers will recall that in the January issue of *NATURAL HISTORY*, Dr. N. J. Berrill discussed the curious manner in which the fish known as the grunion spawns only at certain times during high tide in California. The following letters and comments shed additional light on this interesting habit and may prove useful to those who wish to observe the grunion during the current breeding season:

SUNS:

A relative to whom I presented *NATURAL HISTORY* Magazine at Christmas and who is an experienced sailor has taken issue with certain sentences in the article "Breeding and the Sun and Moon" . . . The sentence he questions is on page 22 and reads as follows: "If they were laid at the dark of the moon, they would have to wait a month to be hatched, for the intervening tides of the full moon are never as high as those of the dark of the moon."

My relative says that this is not only not true but that it directly contradicts an earlier statement on page 21 of the same article, as follows: "On the second, third, and fourth nights after the full moon (that is, on the highest spring tides of the months of March, April, May, and June) . . ."

This young man has had a great deal of experience with tides, whereas I know nothing about them except that I had always taken it for granted that tides are highest at the time of the full moon. If he is wrong, I should like to know it . . .

Mrs. H. M. SINCLAIR.

Toledo, O.

Many persons assume, like Mrs. Sinclair, that a full moon produces the highest tides, and as a matter of fact, it sometimes does, contrary to the statement in our article. The sun and the moon are both instrumental in producing the tides, but because the sun is very much farther away from the earth than the moon, its effect is less strong. When the sun and the moon are on opposite sides of the earth (full moon), they pull in opposite directions. When they are on the same side of the earth (new moon), they pull in the same direction; and it might be supposed that this would produce the highest tides. However, it is impossible to make a general statement, because a number of factors tend to modify the moon's influence, such as its distance from the earth at the time of the occur-

rence, its declination, and the geographic latitude of the place. Hence it is quite possible for a full moon to produce higher tides at a given time and place than a new moon, even though the latter has greater assistance from the sun.

The author of the article informs us that he did not have the distinction between the two types of spring tides in mind when he wrote the sentence referred to above and that it should have read "the high spring tides" instead of "the highest spring tides." He further writes that "With regard to the Pacific coast, my authority for the statement in question (namely, that the new moon tides in the spring months are the higher) and for the manner in which the grunion takes advantage of it, is E. K. Ricketts' *Between Pacific Tides*. Knowing Ricketts as I do and the extent of his experience, I have no reason to doubt his correctness. What holds for these regions may by no means be true of other places, so many factors play a part . . . I believe the account and interpretation of the grunion's habits to be essentially correct, and at the same time I do not doubt that Mrs. Sinclair's sailor relative has faith-

fully expressed his experience to the effect that full moon tides can be higher than new moon tides in spring."—En.

From grunion fisherman John Hnmphreys of Ventura, California, we received the following interesting details:

SUNS:

Dr. Berrill states that the grunion come up on the beaches to spawn on the second, third, and fourth nights after the full moon, and this statement is correct. But I wish to point out that they also spawn at the time of the new moon—in other words, twice a month: on the second, third, and fourth nights after the full moon and also on the second, third, and fourth nights after the new moon.

I live in a beach house in southern California. The sand directly outside my front door is the best grunion ground I have ever found. Catching these delectable little fish is an enthusiasm of mine, and I have caught them by the hundreds on the new moon tide. Indeed, the dark nights of the new moon tides serve my purposes better than do the moonlit nights of the full moon tides. As Dr. Berrill explains, the night of full moon,

*Continued on page 244*

*NATURAL HISTORY*, JUNE, 1948



WAYSIDE DINER: An interesting nature study by Al Schacht

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## THE COVER THIS MONTH

A White-tailed Deer fawn about seven weeks old, photographed in north-central North Dakota by C. P. Grant, provides the cover design on this issue of NATURAL HISTORY.

This graceful, gentle, and appealing animal can be seen by a careful observer in almost any part of the United States but especially in the East. It is the animal made famous in *The Yearling*. White-tailed Deer especially like second growth trees and shrubs or thickets, and in some sections of the country they are probably more numerous than they were in pioneer days. They get their name from their habit of flicking the tail upright when alarmed. Though they are ever ready to flee on their slender, high-stepping legs, they are not without curiosity and may return cautiously to stare at a strange object. The bucks carry antlers most of the year but shed them in January.

The White-tailed Deer is a favorite animal among children, owing to its inclination to become friendly; but a suddenly angered or frightened deer can inflict serious damage with its front hoofs. One should not render a deer dependent upon human aid at one season only to leave it to the whims of weather or hunters the next.

PUBLICATION OFFICE: American Museum of Natural History, Seventy-ninth St. at Central Park West, New York 24, N. Y.

EDITOR: Edward M. Weyer, Jr., Ph.D.  
Elizabeth Downes, *Editorial Assistant*.  
Atherlie E. Karp, *Editorial Assistant*.

Magazine subscriptions, Membership applications, and Advertising inquiries should be sent to Charles J. O'Connor.

ART AND PRODUCTION: Robert E. Williamson.  
Jean Bruck, *Assistant in Art and Production*.

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*The American Museum is open to the public every day in the year without charge*

especially if the grunion run falls on a week end, is a moonlight festival for all the high school and college youngsters for miles about. They build big bonfires by the thousands, shout and yell, and have a wonderful time—and scare all the fish away. So I prefer to catch grunion in the dark of the moon. Of the thousands who hunt grunion by moonlight, very few seem to know about the run in the dark of the moon.

Another reason I like the dark of the moon is that bright moonlight sometimes washes out the beam of a flashlight. The sharp beam of a good light on a dark night catches the fish like swift silver lizards.

Dr. Berrill states that the grunion run during March, April, May, and June. They also run abundantly during July, and it is even possible to catch them during August. By Labor Day the runs are over, but I have caught plenty of these fish during July and August.

Dr. Berrill states that grunion come up on the sand in pairs, male and female. I am glad to know this fact. They sometimes come up in such numbers that I have been unable to judge the proportion of the sexes. I have, however, found females buried tail first with two or three males alongside them. Also, I find that I catch females oftener than males, in ratio of about three to one. This may be because the males, being smaller and far more agile, are swifter in escaping. Incidentally, on the second night after the moon (the first night of the run) it is common to see only males, which come up and go out on the same wave without resting on the sand. When I see this condition, I go home to bed. But I know that the next night will surely bring a full-scale run.

I believe that Dr. Berrill's statements about grunion coming up on the tide's highest waves are too closely reasoned. For one thing, they do not start to run abundantly until about twenty minutes past the turn of the tide. They continue to run, on a good night, for one or two hours, or even longer. Occasionally, when a wind has pushed the waves into big ground swells, they fail to run at all on the scheduled night. On nights of exceedingly bright moon, they sometimes seem nervous, showing themselves in the waves but refusing to remain on the beach. Often, for no reason that I can find, they simply delay their run for an hour or two. One night last summer when the tide book indicated that they would run at 9:40 (the high tide), I recall that they appeared abundantly about midnight. Occasionally, when they are driven by bigger fish (which I guess to be corbina), they also exhibit nervousness, refusing to remain on the beach. Some of these conditions may, of course, be local; but it is a fact that grunion

often spawn as late as two hours after the high tide.

I question whether grunion on the beach go out "with the wash of the next wave." Undisturbed, a female will remain on the beach for two or three minutes. Sometimes she is in the wash of the wave; sometimes she is high although not dry. A high wave comes in, then two or three smaller waves, then another high one. If the female comes in on a high wave, she will remain until another high wave reaches her, or she will spend as much as two minutes flopping along the wet sand to reach the water again. These fish can swim in a mere slick, almost in damp sand, the small males especially. The bigger females can swim quite well in half an inch of water.

Although grunion come up on the beach in moonlight if it is not exceedingly bright, they can be frightened by the beam of a flashlight on a dark night. As soon as it hits them, they take out to sea. They are also frightened away by the thud of running feet on sand. They seem to avoid areas lighted by electric floodlights. Along my beach we think we increase the chance of a catch in some areas by turning the house floodlights on and thus herding the fish. However, I once saw an enormous run in a brightly floodlighted space near the Santa Barbara wharf, with dozens of yelling people running about. I think these fish have preferences but forget about them if they are spawning in masses. Then anything goes.

About half a mile from my house the highway is a little removed from the beach, and several large culverts allow passageway from the hills to the beach. Along here, the hill animals come down to the beach to cash in on the grunion runs—coyotes, foxes, and skunks—especially skunks. A grunion hunter along that beach must keep his light on the dry sand as much as on the wet, for he is very likely to discover that a skunk turns out of his way for no man.

If you want to catch grunion, get a flashlight (an expendable one, since it is going to get wet and sand is going to get in the switch) and a light bucket with a wire handle, deep enough so that the fish will not jump out. Put on a warm sweater and swimming shorts, because you are going to get wet anyway but might as well be warm and wet. Go out twenty minutes after the high tide and get well away from other hunters, especially from beach bonfires and parties. Stand still until a good, big wave comes in. Wait until the beach is free of water, for if there is still merely a feather of water, you won't catch fish. Then turn your light on as far ahead as the beam will carry, and start running so as to cover as much beach as possible. If you see fish, shift your light and pail to one hand and grab with the other. Sometimes you catch a fish; oftener you don't.

Occasionally, you will fill your pail in five minutes. Then you move on, because the far beach always seems to have better fish than your own.

One night last April I met four other grunion hunters, and we all agreed that when the sand underfoot is firm so that our feet do not sink in, we may as well move on. The fish may come up with a wave on such a place, but they are almost certain to go out on the same wave, and such behavior profits a grunion hunter very little. But where the sand is soft and our toes sink into it with every step, there the grunion will stay. The females need very soft sand, of course, for digging themselves in, since they accomplish this somewhat astonishing feat by wriggings of tail and fins. I have never observed this act precisely, although I have found them buried, with the males alongside but covered slightly, if at all. I wonder whether the high tides bring in sand, thus making the beach soft and providing a good seed bed.

A state law forbids the use of nets for grunion catching; it is one of the few types of fishing reserved for a bare-handed fisherman.

When you have finished catching grunion and go home, you pay the price for catching them—you clean your fish. They must be cleaned at once and put on ice, or the flavor turns strong. Once cleaned, scaled, and iced, they keep well for days, and any time the fancy takes you, you can have a wonderful fish for lunch. They should be only pan-fried, carefully so as not to break them, or deep-fried crisply. This is one of the few fish that must be slightly overcooked to be at its best. Properly crisped, grunion is delectable either hot with lemon or cold with mayonnaise. But I warn you, it's no use to experiment. My wife has tried a dozen other methods of cooking grunion, and all of them ruin the fish, especially anything having to do with olive oil or tomato sauce. Instead of tasting as much like brook trout as a salt-water fish can, they suddenly taste like something an alley cat would like.

I was happy when I came across Dr. Berrill's interesting article, for it revived all my winter-stored enthusiasm for grunion.

#### Snake Control

SIRS:

I have just finished reading "The Problem of Snake Control" by C. M. Bogert. Your magazine certainly has too fine a record to print such an article. Don't snakes have enough enemies as it is, without printing such a destructive piece of propaganda? The mind of the average citizen is filled with unfounded prejudices and superstitions against all snakes, and reading this article would, in most cases, only add to one's fear and dislike of them. Certainly, this is not the purpose of a magazine dedicated to the better understanding of wildlife.

Continued on page 287

# YOUR NEW BOOKS

## SUPERSTITIONS • YUCATAN • CAVES FISHES • SAN ILDEFONSO POTTERY

### MARIA: THE POTTER OF SAN ILDEFONSO

----- by Alice Marriott

University of Oklahoma Press,  
Norman, Okla., \$3.75  
294 pp., 35 drawings

THIS is the life story of Maria Martinez and her husband, Julian, who did more to revive the ancient craft of pottery making at Pueblo San Ildefonso near Santa Fe, New Mexico, than any other Indians. Marie, as she signs her pottery, made the vessels, and Julian decorated them. Julian was, until his untimely death five years ago, the best-known artist. All his frechand decorations were drawn with such perfection that one of our leading authorities on primitive pottery remarked after Julian's passing, "There will never be another Julian."

Marie is one of whom it may be justly said, "She has become a legend in her own life-time."

The author, Alice Marriott, is a trained ethnologist, who three years ago first demonstrated her ability to write, in her book about the Kiowas, *The Ten Grandmothers*. Last year she published *Winter Telling Stories*, a book of Kiowa Indian stories for children. She shows a great variety in her approach, which makes each book a delightful surprise. In her biography of Marie, Alice Marriott has fully justified the promise given in her first two books.

Marie is allowed to tell her own story, which she does with simplicity and dignity. It follows the pattern of the Pueblo, and as Marie's life slowly unfolds we feel Alice Marriott weaving her spell. The book begins with Marie as a five-year-old merchant selling cheese, made by her mother, to other Indians. Marie selected early in life the road she wished to follow, and she lifted the entire Pueblo to a higher economic level. When a very small child, she was taught by Tia Nicolas to make small pottery dishes. After she had married Julian and they had children, her husband's contact with archaeologists led to the growth of their serious interest in the pottery art. She and Julian reproduced pottery similar to that dug up from the ancient ruins, and through a mishap in firing they made their first black pottery. Later Julian discovered the method of "black on black" pottery which has made these two personalities famous. Through their life story, Alice Marriott tells us the various steps in pottery making, and the book reaches its climax with their invention of black designs on black vessels.

Margaret Lefranc's careful drawings of the Pueblo and of pieces of pottery made by Marie and Julian add greatly to the value of this delightful volume. All in all, we have here a fascinating biography of two famous primitive artists.

TE ATA.

### TREASURY OF AMERICAN SUPERSTITIONS

----- by Claudia de Lys

The Philosophical Library, \$5.00  
494 pp.

THE title of this excellent compendium provokes several unhappy thoughts. First, Americans are no less prone to superstitious belief than are other people, although many of the superstitions in this collection originated in other lands and in ages long past. Second, if a treasury is a storehouse of wealth, then this storehouse of American superstition is full of a kind of wealth we could just as well do without.

Claudia de Lys presents a cleverly and carefully planned survey of unusual beliefs and practices, superstitions and stubborn errors that apparently persist because they are all practically a part of American folklore. She has filled twenty-four chapters with well-written, interesting, and often amazing accounts of hundreds of superstitions. What is even more important, Miss de Lys explains in each case why the superstition is a superstition. Wherever possible, she has provided in each instance the rational and scientific evidence that serves to "debunk" the superstition.

We meet many "old friends" in the pages of this book. Here are black cats, broken mirrors, spilled salt, snakes that milk cows, crossed fingers, and howling dogs. Here are superstitions dealing with all phases of human life from birth to death. The birds and the beasts are here, men and women are here, stones and stars and even the ill-fated two-dollar bill are dealt with in their proper places. This is a book of the lucky and unlucky, a book of the cursed and the blessed, a book which, in the words of the author,

### NATURAL HISTORY BOOKS *Old, Rare and Out of Print*

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Box 248

Mt. Vernon, N. Y.

has as its aim the clarification of "the approach to seemingly mystifying questions" and the "clearing of the mind of any possible fear or prejudice."

One who owns and reads this book soon realizes that there is scarcely a single thing in man's environment or behavior about which there has not been woven a skein of mysticism and superstition. One who reads this book will realize that there still persists, in this the third year of the Atomic Age, a sizable amount of stubborn error and superstition in the minds of men.

This book can be recommended as an antidote for smugness, a tool for truth, and a delightful though foreboding adventure into folklore.

JOHN R. SAUNDERS.

### EMERSON TUTTLE

Fifty prints. With an introduction by Chauncey Brewster Tinker, a Critique by Lewis E. York, and a complete catalogue from 1921 to 1946

Yale University Press, \$15.00  
29 pp., 50 plates

SELDOM are artist and ornithologist combined in one man. There have been ornithologists who were competent illustrators, but rarely one who was a great painter. The artistic soul is little concerned with the minutiae of bird study. What diversity one finds in the appreciation of an Audubon among ornithologists!

Emerson Tuttle was a talented teacher of English, and the first Master of Davenport College at Yale University. He was fond of birds, of hunting, and of trout fishing, and he became a proficient etcher. Among artists he quickly gained recognition; some of his prints were acquired by museums of the first rank.

The present volume presents 50 fine prints from 177 plates executed between 1921 and 1946, and it includes a catalogue of the whole collection with reproductions in miniature and notes on methods of work. Of the larger illustrations, 43 show birds, 5 landscapes, one a squirrel, and one a trout. Owls were clearly the artist's favorite subject, being treated in eleven plates; diurnal birds of prey appear in six. Grouse and shore birds, woodcock, ravens, and ducks come next in order.

To the artist they make gratifying pictures; to the bird specialist most of them are less satisfactory. Softness of feather-

ing is there, facial expression is often excellent, but details of attitude, anatomy, or movement may well disappoint the man who scrutinizes wild birds and checks his impressions with modern photographs. The plate of the running soras is decorative, but rails do not run that way.

Professor Tinker pays tribute in the introduction to a dear friend who worked bravely under physical handicap. The critique by Lewis York points to the technical excellence of the etching. This book is to be accepted as a memorial to a noble soul and a feast for artistic eyes.

JAMES P. CHAPIN.

## THE MAN-EATING LEOPARD OF RUDRAPRAYAG

----- by Jim Corbett

Oxford University Press, \$2.50  
188 pp., 4 illuts.

THIS is a companion volume to the *Man-Eaters of Kumaon*, and like that account gives a revealing insight into not only the behavior of the animal but the reactions of a fear-paralyzed people. The language is forthright; there is little left to the imagination. The author had a job to do in hunting down the man-eater, and he set about it in the most direct manner. His story follows the same pattern.

The central figure is a leopard which killed 125 human beings over a period of eight years. This animal lived upon the inhabitants of Garhwal and would not accept a domestic animal if allowed any choice in the matter. The strength and cunning of the leopard were extraordinary, and he escaped gun, trap, and poison so often that it was commonly believed the beast was supernatural. The unarmed natives went into their dwellings at sundown or took what cover was available, but the ruthless leopard broke down barriers and displayed such indifference to the presence of humans, often in numbers, and to their homes that people were as helpless as cattle.

The reader will be appalled to learn that the conditions described in this book can actually exist in the present era. The animal is obeying the primal urge of hunger; he has discovered that there is little to fear from man as he finds him; it is only logical that the leopard should continue a practice that is so successful. But the fact that this toll on human lives could be taken over a period of eight years is a sad commentary on the psychology of the Indian. Passive resistance had no effect on the leopard.

Corbett is an able and experienced hunter, but even his knowledge and skill is set at naught by the leopard. The man risks his life frequently on his nightly watches for the animal. It is a fair chase, and the words of the author disclose an unusual understanding of the leopard he is trying to kill. Human lives are at

stake, and the man-killer must be destroyed at the earliest possible moment. Nevertheless, and notwithstanding the tragedy from the human point of view, the action that takes place is only what might be expected from the leopard's point of view.

H. E. ANTHONY.

## UNDERGROUND EMPIRE

----- by Clay Perry

Stephen Daye Press, \$3.50  
221 pp., 33 illuts.

THE second volume of Clay Perry's *American Cave* series sinks its teeth into some real caverns, for New York State is far richer in limestone, and consequently, in true solution caves, than is New England. A reading of the book reveals that caves, natural bridges, and long caverns decorated with stalactites and stalagmites are more abundant even than one would suspect from the advertised caves of the roadside. Howe Caverns is briefly described, but it is surprising how prosaic its history seems, in comparison with the bloody details recounted for other unsung (deservedly) caverns in which the state abounds.

Possibly the very abundance of caverns is what makes the book so difficult to read, for one drops from chamber to precipice so rapidly that they are soon confused in the mind of the reader. One begins to wonder why the inhabitants of the state do not drop out of sight at an alarming rate in yet undiscovered clefts. In addition, Mr. Perry has listed a few of the man-made openings in the earth, the salt mines near Warsaw and some of the old iron mines of the Lake George region. Far larger metal mines elsewhere in the state have been omitted, a necessity since New York has far too many for a cave book.

Like its predecessor, Mr. Perry's book is an excellent guide for those whose interest in "spelunking" is intense, but for the casual tourist who will take his caves or leave them alone, the sequence is a little hard to follow. The chatty style is somewhat amateurish when read in book form, appropriate though it may be to a club journal. A map of the state in which the principal caverns were located would have made a useful end paper in place of the duplicated map of a single cavern which appears beneath both covers.

F. H. POUCH.

## AUSTRALIAN NATURE STORIES

----- by Donald K. Monro

Robertson and Mullens, Melbourne,  
Australia, 10 shillings/sixpence  
116 pp., 132 illuts.

THIS attractive little book was written and illustrated by one of Australia's most promising younger naturalists. The

introduction was written by the well-known pioneer Australian naturalist, Charles Barrett. The untimely death of Monro, which occurred soon after its appearance, makes this a memorial volume. It is evident that the author had extraordinary skill as an outdoor photographer, all the illustrations being from his own camera. He also has an unusual facility for nature writing. His experience both in photography and in writing was gained mainly through years of newspaper work.

This reviewer cannot recall any book which is at the same time so well suited to children and to adult nature lovers. One might be bothered by the anthropomorphic point of view in parts aimed toward childhood interest, if it were not that the whole book is so full of accurate natural history. The author was a dependable naturalist, whose enthusiasm prompted him to discover much and to interpret it in an appealing manner. He realized, with our John Burroughs, that man can have but one interest in nature, namely, to see himself reflected or interpreted there, and that we quickly neglect both poet and philosopher who fail to satisfy in some measure this feeling.

The pictures are numerous and uniformly excellent, some of the best being those of the Australian Teddy bear (the Koala), the series of the rare Royal Spoonbill, the Straw-necked Ibis, the flashlight of a Boobook Owl bringing home a Honey Eater to the two babies, and those of the Nuthatch with its amazingly camouflaged nest.

But Donald Monro was much more than an expert photographer. He had the rare gift for weaving fact and fantasy into a simple story without sacrifice of scientific accuracy—a rare gift indeed.

CLYDE FISHER.

## A FIELD GUIDE TO THE BIRDS

----- by Roger Tory Peterson

Houghton Mifflin Co., Boston, \$3.50  
290 pp., 85 illuts.

SINCE its first appearance about fifteen years ago, Peterson's *Guide* has become almost indispensable to field bird students of all levels of experience. It won for its author the coveted Brewster Medal of the American Ornithologists' Union, awarded for outstanding publications on American birds.

The present revised edition is really more than that; all of the illustrations are new and much of the text has been rewritten and expanded. The book now contains 60 plates, 36 of them in color as compared with 4 colored plates in the first edition. Almost all of the more than 400 species of birds occurring in North America east of the Rockies, the area dealt with by this guide, are figured, some of them, like the waterfowl and warblers, in a number of different views or plumages. Silhouettes and other black-

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and-white drawings stress the importance of pattern and shape in identification. In all, there are about 1000 figures.

For each species, Peterson has written terse paragraphs on Field Marks, Range, and usually on Voice, and Similar Species. He has utilized the suggestions of many correspondents as well as his own wide experience. A few species have been written up by other experts. The legends to the plates repeat the salient recognition marks for each species, and these are indicated by pointers on the drawings themselves. As regards subspecies, only the few recognizable in the field are included in the main text; the others are wisely relegated to an appendix. The introduction gives hints to the beginner and a "Life List" on which to check off the birds he has identified.

Like the late Ernest Thompson Seton, who is mentioned in the preface, Roger Tory Peterson is a gifted artist-naturalist. His book seems destined to become one of the classics of American ornithology.

DEAN AMADON.

## THE CORRIDOR OF LIFE

----- by W. E. Swinton

Jonathan Cape, 30 Bedford Square,  
London, England, 15 shillings  
223 pp., 89 illus., 1 folding chart

THE author of this book, a paleontologist of distinction who is in charge of fossil amphibians and reptiles at the British Museum (Natural History), compares his account of the history of life on the earth to a walk down a hotel corridor, where in front of the doors on either side are shoes and boots waiting (as is the custom in Britain) to be polished. Similarly, it is the task of the paleontologist to reconstruct the story of ancient life from the fossils in the ground.

This book goes back beyond the beginning of life to discuss briefly the origin and constitution of the earth. After a digression to introduce the reader to the historical background of paleontology, the author continues with a discussion of the origin of life—a difficult subject of which we know all too little. From this point on, the book follows a more or less conventional pattern, tracing the evolution of animal life from the most primitive protozoans through the various phyla of invertebrates into and through the classes of vertebrates, or backbone animals.

About half of the book is devoted to the origin of the earth and of life and to the invertebrate animals; the remainder is concerned with evolution in the fishes, amphibians, reptiles, birds, and mammals. There is a final chapter dealing with problems of evolution and extinction.

This book, intended for the lay reader who has no background in the natural sciences, is simply written in a lively style that should be easily comprehended by many readers. Unfortunately, in a book

of such limited size and covering such a vast subject, there are of necessity many condensations and omissions. This may not be a serious fault in the eyes of the public for whom the book was written.

It would have been very helpful if an outline classification of animals had been included, to aid the reader in orienting himself through the discussions of the various groups of animals described. The illustrations by Erna Pinner are uniform in execution, a great advantage in a book such as this, but perhaps not so uniform in effectiveness.

EDWIN H. COLBERT.

## FISHES OF THE GREAT LAKES REGION

----- by Carl L. Hubbs and  
Karl F. Lagler

Cranbrook Institute of Science,  
Bloomfield Hills, Mich., \$3.00  
186 pp.

THE authors say they have tried to make this expansion of their 1941 book more useful "for those who would learn something of the fishes of the region." This is a very modest statement about a book obviously destined to become a classic. Its first edition is being used at present by all ichthyologists and innumerable students and laymen as an authoritative source of information about all the native and stocked fishes of the Great Lakes region.

Various additions and alterations make the new edition even more valuable than that of 1941. Some fine color plates have been added; with the Key to the Families there is a line cut of a typical fish of each family; and size is indicated in the improved captions of the already famous series of half-tone plates in the back of the book. An interesting and useful paragraph has been added under each family section, giving a short summary of the outstanding characteristics, general distribution, and something of the habits of the family.

There are a few changes bringing classification up-to-date, as where further study has failed to justify subspecific distinction (for example, in the Shasta Rainbow Trout) or where a species has been rediscovered. These changes, although few, illustrate the extreme care with which the book has been prepared. Common names have been added everywhere. The drawings explaining the anatomical terms that are used in the simplified keys make it easy for the layman,

## SEA AND LAND SHELLS

If you are a buyer of this class of invertebrates send for my Conchological Chatter which appears monthly listing choice Mollusca from every part of the world. Collections for sale of any size up to 5000 species. Also books on Mollusca.

WALTER F. WEBB  
2515 Second Ave. North. St. Petersburg 6, Fla.

who not infrequently contends that any key is too difficult to use because of the scientific terminology.

Methods of measuring, collecting, and preserving fishes are clearly stated, and the collector is told what notes he should take.

As in the other edition, there are simplified keys under each family, followed by short paragraphs giving the distribution and habitat of each species in the key.

This is a perfect textbook for students, and a reference book which no one interested in fishes should be without.

F. LAMONTE.

## TEMPLES IN YUCATAN

A Camera Chronicle of  
Chichén Itzá

----- by Laura Gilpin

Hasting House, \$5.00  
124 pp., 88 illus.

THE author has given us here a companion volume to her beautiful *Camera Chronicle of the Pueblos* which appeared a few years ago. It is evident that Laura Gilpin has lost none of her skill as an artist-photographer. Her rank as one of America's leading outdoor photographers is, if possible, enhanced by this recent book. In short, the illustrations are superb.

Although the pictures predominate, as indicated by the title, the author has prepared a very brief but informative text to accompany them, and this text has been checked in connection with the pictures by Dr. Sylvanus G. Morley, of the Carnegie Institution of Washington, eminent authority on the Maya. In a six-page introduction, Miss Gilpin gives us a carefully prepared glimpse of the geography and history of the Maya country.

Many archaeologists would entirely agree with the author's conclusion, that "Of all the many Indian tribes of the Western Hemisphere, the Maya, perhaps, reached the highest cultural level, leaving behind magnificent temples of unique and remarkable design." Some of these ruins, which have been repaired and reconstructed, furnish the subject matter, both photographic and textual, of this book. Among these astonishingly beautiful and grand structures, not the least interesting is the Caracol, an astronomical observatory, to which the author devotes five striking photographs. A consideration of this structure reminds one of the statement by one of our leading students of Mayan astronomy to the effect that when the Maya were at the height of their culture, they were the best astronomers in the world, bar none.

The little volume is a most attractive camera study of the Mayan city of Chichén Itzá in central Yucatán, Mexico.

CLYDE FISHER.

WHEN the first plans were laid for the Whitney Wing of the American Museum of Natural History, the late Frank M. Chapman, then head of the Bird Department, conceived the idea of devoting one of the floors to an exhibit on the biology of birds. It took 20 years of planning and hard work before this idea became a reality. Although not quite completed, the Hall was opened to the public on May 25. It is only fitting that the Hall should have the name Sanford Hall, in honor of Dr. Leonard C. Sanford, a patron of the American Museum, who has done so much to make the Museum's bird collections the finest in the world.

The visitor to Sanford Hall will see much that is novel, both in subject matter and treatment, for it represents an interesting step in the development of the modern museum. The museum of today has gone a long way from its beginning—the "curiosity cabinets" maintained in the eighteenth century by kings and princes. These old-time museums emphasized the exhibition of curious objects and freaks, with two-headed calves, fossil bones, and sea monsters displayed in the crudest manner. The museum of today wants to be not only attractive but also instructive. These principles are applied in Sanford Hall to a series of exhibits illustrating

#### How Birds Live

The magnificent sunset scene that one sees upon first entering it gives instant assurance that this Hall has been designed to give aesthetic inspiration and to avoid "museum fatigue." It presents a gorgeous view of Caribbean skies fairly alive with white egrets, roseate spoonbills, scarlet ibises, and flamingo flamingos winging their way to a roost at the water's edge. Color and lighting have been utilized throughout the Hall to produce an effect that can scarcely be appreciated from the black-and-white illustrations accompanying this article.

It is sometimes said that birds are nothing but "glorified reptiles." The first exhibit shows that this is quite true. It will be a surprise to many to learn that birds branched

off from the same subgroup of the reptiles to which the crocodiles and dinosaurs belong and that, strictly speaking (in terms of phylogeny), they are more closely related to the crocodilians than the latter are to the turtles.

The exhibits illustrate some of the differences that have developed in birds as compared with reptiles. These are intimately connected with the acquisition of flight, resulting in:

- (1) Modification of forelimbs as wings.
- (2) Dominance of vision over other senses.
- (3) Constant body temperature, connected with high activity.
- (4) Development of specialized nesting and social habits.

Throughout the Hall it is emphasized how flight has affected the structure and habits of birds, down to the smallest detail.

#### Archaeopteryx

It is fortunate for students of birds that the "missing link" between birds and reptiles has actually been found. It is *Archaeopteryx*, a peculiar creature whose fossilized remains have been found in the lithographic slate of the upper Jurassic (125 million years ago!) of Bavaria.

So perfect and intermediate is *Archaeopteryx* that there is con-

siderable argument among authorities as to whether it should be classified as a bird or a reptile. It still has teeth and a long tail with 20 to 21 free vertebrae and several free fingers with claws. It has a reptilian brain, and there are pronounced reptilian features in the skull and "hipbones." On the other hand, it was fully feathered and had wings much like those of modern birds. Though perhaps not capable of long sustained flight, it could surely flutter from tree to tree and prolong its flight by gliding. For me this is enough to qualify *Archaeopteryx* for the title of "The Earliest Known Bird."

The family tree of the birds shows that most of the higher groups, the so-called orders, had been evolved by the end of the Cretaceous period, 60 to 70 million years ago. At least 35 orders of living birds are recognized, such as the penguins, loons, hawks, pigeons, parrots, songbirds, and many others.

#### The Families of Birds

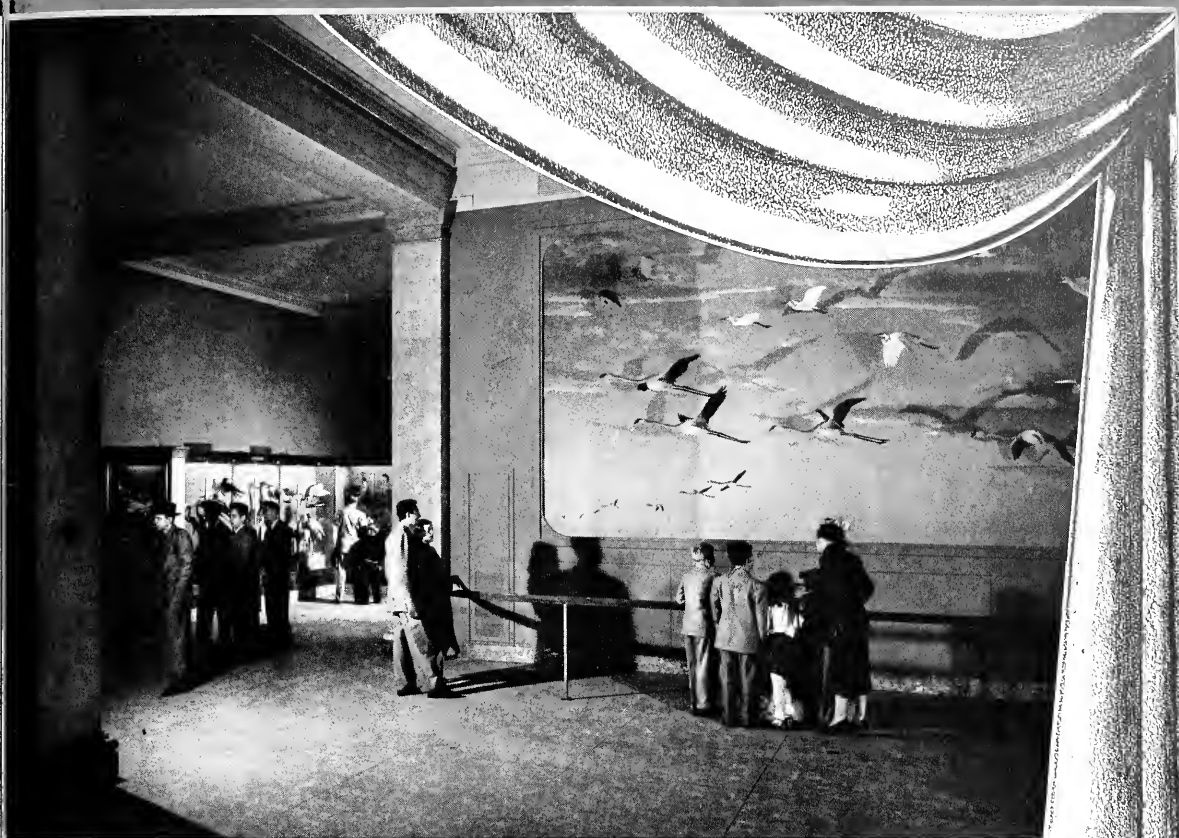
The diversity of birds in all parts of the world is almost staggering. In North America alone, more than 600 kinds of birds are found, belonging to 75 families. The traveler who visits South America, Europe, Africa, or any other part of the world finds that in each of these regions a bird fauna exists that is very

## The New Sanford Hall

Art and science join to create the world's most comprehensive and fascinating series of exhibits on the broad subject of how birds live. A preview of the Sanford Hall of the Biology of Birds, at the American Museum of Natural History

By ERNST MAYR

Curator, Whitney-Rothschild Collections,  
American Museum of Natural History



▲ A MAGNIFICENT VIEW of Caribbean skies greets the visitor upon entering the Hall. White egrets, roseate spoonbills, scarlet ibises, and flamingo flamingos are shown in flight

different from that of North America. In all, about 8600 species of birds are known, belonging to more than 140 different families. The second to seventh alcoves in the Hall are devoted to a parade of the various types of birds, beginning with primitive kinds, rheas and shearwaters, and ending with the highest of the songbirds.

The birds in this synoptic exhibit are not displayed on the traditional shelves of the standard museum cabinet. Instead, novel methods have been employed to create a pleasing result. The ducks and grebes, for example, are mounted in swimming poses on a blue background, producing a very natural effect and enabling the observer to see the foot action.

Among the 1056 birds exhibited there are some very beautiful as well as rare specimens, such as a Coscoroba Duck (South America), a Crowned Eagle (Africa), a Congo Peacock (Africa), a Tuamotu Sandpiper (Pacific), a Pigmy Parrot (New Guinea), a Quetzal (Central

America), a Shovel-billed Kingfisher (New Guinea), a Lyrebird (Australia), and a pair of Huia (New Zealand). It is doubtful that such an assemblage could be seen anywhere else in the world. Special panels have been prepared to show some of the most colorful birds—South Sea Doves, Parrots, Hummingbirds, and Pittas. The hummingbirds alone are worth a visit to Sanford Hall. This exhibit shows 40 of the most interesting and beautiful of these feathered jewels of the air.

#### Extinct Birds

More than 100 kinds of birds have become extinct during the past two centuries, including such well-known North American species as the Labrador Duck, Heath Hen, Eskimo Curlew, Great Auk, Passenger Pigeon, and Carolina Parakeet. A large world map shows 60 ex-

tinct birds in various parts of the world and demonstrates that islands are the most vulnerable regions. Not a single bird has become extinct in Africa and only one or two in Asia, South America, and Australia, whereas the Hawaiian Islands and New Zealand have lost a considerable proportion of their native fauna. Extinction is due to many causes, but man is nearly always involved, directly or indirectly. This world map of extinct birds is an eloquent plea for conservation.

#### Giant Birds of the Past

The Trumpeter Swan, with a weight of about 35 pounds, is the largest flying bird. The Great Bustard is almost as heavy. This weight seems to be near the upper limit consistent with flight, owing to the fact that the wing surface grows by the square, while body size and



◀ AN AMERICAN EAGLE, our national bird, which decorates one of the six alcoves

many times daily through the small opening. After the young have hatched, the male feeds mother and young. The female finally breaks out of confinement, and soon afterwards the young bird joins its parents.

### Bird Flight

Birds are the best flyers in the animal kingdom. One of the most interesting exhibits in the Hall (and we might add, one of the most difficult to make) is the one explaining bird flight.

A body must create two forces if it is to fly: lift, to overcome gravity, and forward propulsion, to overcome drag. Birds are much like airplanes, but they produce both lift and propulsion with their wings, whereas in an airplane propulsion is produced by the propeller and lift by the wings.

The simplest types of flight are gliding and soaring. Even the best gliders, however, lose altitude unless they either flap their wings occasionally or soar on up-currents. This is the reason why one sees soaring hawks circle over the edge of the forest or over cliffs or any other place where there is an up-current of air.

The principle of flapping flight has been understood only quite recently. It was long believed, and is still stated in many books, that the bird lifts himself somewhat with each wingbeat and loses altitude again between beats. A single glance at a flying Gull or Blue Jay shows that there is no such up-and-down motion with each wingbeat.

weight increase by the cube. To keep up with the rapid increase of weight, wings finally reach a size where they become too unwieldy for flight.

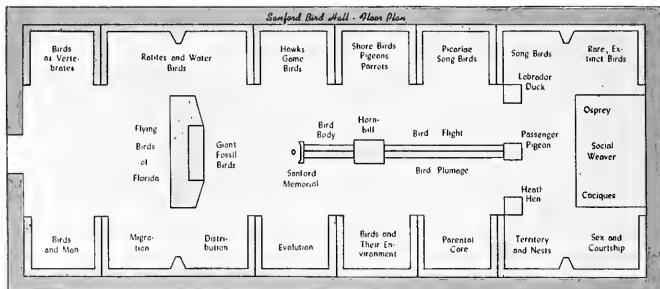
There is no such upper limit for flightless birds. The Emu and Cassowary weigh nearly 100 pounds or even more, and the Ostrich 150 to 300 pounds. Still, even the giants among living birds appear small when compared with some of the extinct birds. The Giant Moa from New Zealand stood about 9 feet high and weighed about 500 pounds. The Elephant Bird from Madagascar, though hardly taller, was a stockier bird and weighed up to 1000 pounds.

North America, too, had some lesser giants among its prehistoric birds. *Diatryma*, a peculiar bird that lived in Wyoming over 50 million years ago, was larger than the Ostrich.

### Nests

One of the most astonishing exhibits at the far end of the Hall is a neatly constructed bird's nest of grass larger than an office desk. This is the communal nest of the African Social Weaver, and it was brought clear from Africa in the tree in which it was built. The enormous structure is the work of only about a dozen pairs of birds.

Other examples of the work of birds as architects include a colony of what might be taken to be gigantic oriole nests hanging from the branches of a tree. These are the nests of Central American caciques, relatives of our orioles, and their nests, though conspicuous, are well protected by their inaccessible location. But perhaps the most curious nest of all is that of the hornbills. These birds nest in hollow trees, but as soon as the female is ready to lay her eggs, she is walled in by the male. The closing up of the nest opening with mud, with only a narrow slit through which the female can accept food from the male, gives the birds excellent protection against marauding predators and tree snakes. For many weeks, the male brings food and feeds the female





◀ THE MALE HORNBILL walls in the female and feeds her through a narrow slit during incubation. A cutaway view showing one of birddom's strangest homes

(The undulating flight of finches and woodpeckers is an altogether different matter.) Flying is actually the equivalent of rowing a boat. Just as each stroke of the oars gives the boat forward propulsion, which is quickly lost again through the "drag" of the water, so is the bird driven forward by the downbeat of its wings. It can be shown that the air is thrown backward during the downstroke of the wing. This is what gives the bird propulsion.

#### **The Bird's Body**

Though birds are fundamentally nothing but winged reptiles, the body has been thoroughly modified to make them efficient flying machines. Their high body temperature (104 degrees to 108 degrees is normal in birds) helps them to maintain their high activity. Their circulatory system, though evolved independently, is like that of the mammals in that the two chambers of the heart are completely separated. Thus arterial and venous blood do not mix as they do in the reptiles and other cold-blooded vertebrates.

During flight, intense muscular activity produces much heat in the bird's body. Birds are well insulated in their dense plumage, and they have no sweat glands. How, then, do they cool off? What prevents

them from "boiling over?" The fact is that birds are the inventors of internal "air conditioning." Connected with the lungs is a whole system of "air sacs," long, tubelike, membranous bags which extend through the whole body, even to the inside of the bones. With every wingbeat, the bird empties the heated air from these air sacs and replaces it by cool, new air. Dur-

ing breathing, also, the air in the air sacs is partly renewed, the bird being able to adjust the amount of ventilation at will.

Truly a miracle of Nature in this and other developments, the bird evokes endless wonderment from the specialist and the amateur alike. Sanford Hall permits us for the first time to present on a popular level many of these facts that are little known to the general public.

#### **The Bird's Feathers**

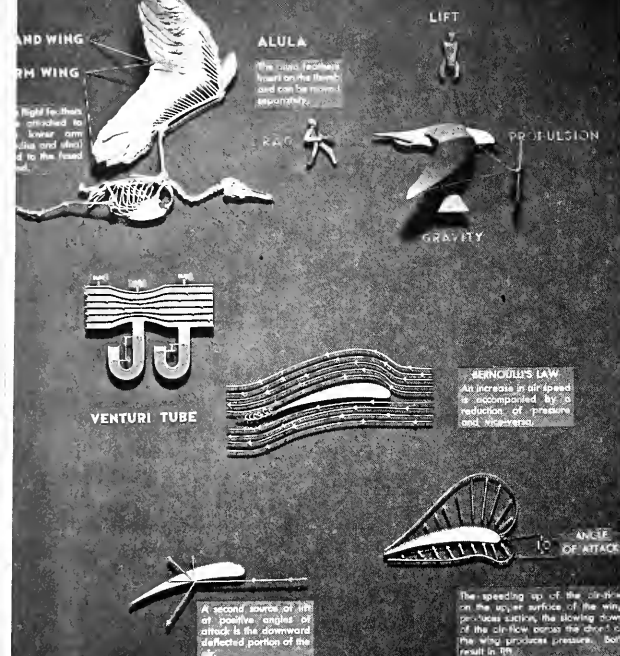
The origin of the bird, as distinct from previous forms of life, has been made possible by the origin of feathers. A wing composed of individual feathers is a much more efficient and elastic instrument of flight than the wing membranes of all other flying creatures from butterflies to bats.

The feather is a wonderful organ,



➤ NESTS OF CENTRAL AMERICAN CACIQUES, relatives of our orioles, illustrating protection by inaccessible location

## WING AND FLIGHT FORCES



## EFFICIENCY DEVICES



combining, as it does, lightness with a strength and flexibility not equalled in any man-made material. The number of feathers varies according to the bird, its age, and the season. On a Ruby-throated Hummingbird in June, 940 feathers were counted. A Whistling Swan in November had 25,216.

Bird feathers do not grow throughout the year but only during rather short molting seasons. Then the old, worn feathers drop out and new ones grow in their place. Most birds, at least in the temperate zone, have two molts. A male Wood Duck, for example, has a beautiful nuptial plumage from October to May. As soon as the young arrive, this is molted into a drab, inconspicuous summer or "eclipse" plumage. Other birds, like the tanagers, goldfinches, and our warblers wear their inconspicuous plumage during winter and the

bright plumage during the breeding season. Feather structure, plumage, and the color of feathers are illustrated in Sanford Hall in an exhibit covering six panels.

### Bird Migration

Since ancient times, people have wondered where birds go during the winter. A piece of woodland near New York City, teeming with thousands of birds during the summer, is almost deserted during the winter. You will see an occasional Chickadee, Blue Jay, Downy Woodpecker, but where are all the Red-eyed Vireos, Ovenbirds, and Redstarts that were evident only a few months earlier?

Only 200 years ago, the great Swedish naturalist Linnaeus still entertained the idea that birds hibernated, like frogs and toads, in the mud of lakes. We now know, as did that amazing naturalist of

the Middle Ages, Emperor Frederick II, that migratory birds pass the winter in warmer zones.

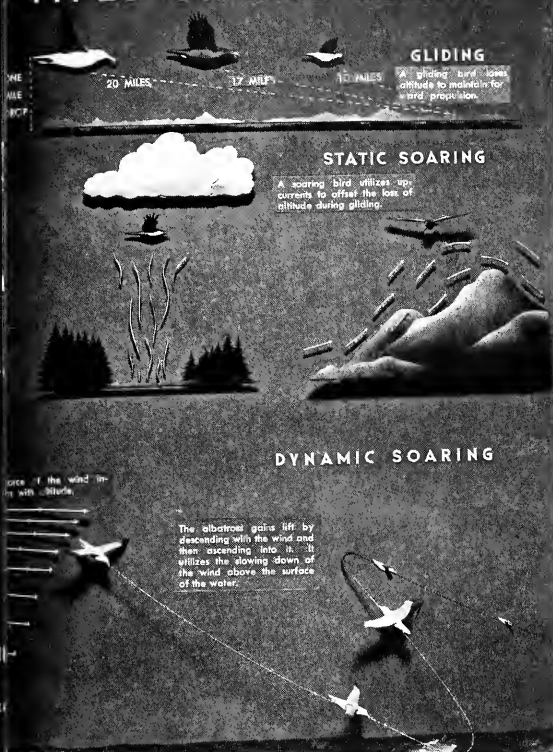
Why do birds migrate? There are three possible answers to this question, depending upon what is meant by it.

(1) Birds migrate because seasonal variations of the food supply make it advantageous to spend part of the year in a different region. No cuckoo or flycatcher or other strictly insect-eating bird could survive a northern winter, though the food supply is plentiful there in summer. This is the ecological cause of migration, the cause that depends upon a bird's relation to its environment.

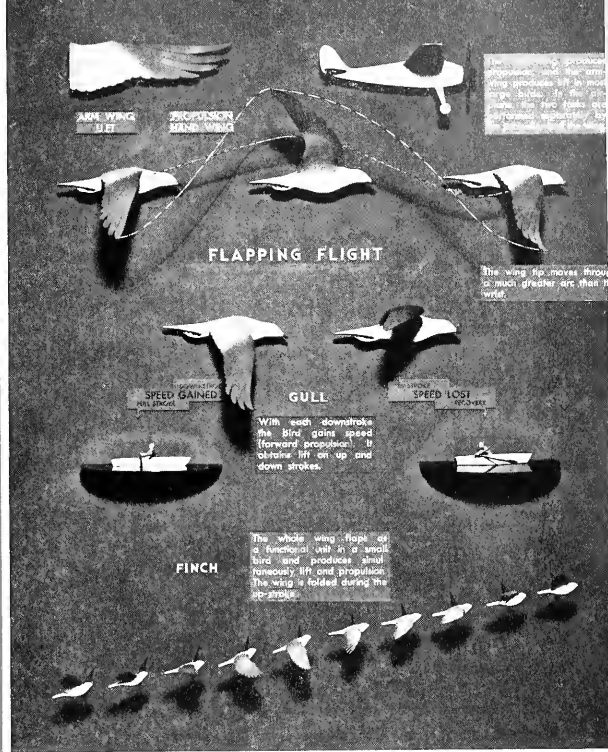
(2) Birds migrate because they have a genetic disposition to migrate. There is an abandoned apple orchard back of the author's house in which Screech Owls and Blue-winged Warblers nest. Even though



## TYPES OF BIRD FLIGHT



## TYPES OF BIRD FLIGHT



the environmental conditions are exactly the same for the two kinds of birds, the Screech Owl stays there throughout the year, whereas the Blue-winged Warbler departs in the middle of the summer (July-August). He has a genetic disposition to migrate.

(3) The third cause of migration is the physiological cause. Birds migrate at a certain date because their nervous system and endocrine glands respond in a genetically fixed manner to a constellation of environmental factors. Among these, the length of daylight is by far the most important; temperature comes second.

How birds find their way during migration is a great, unsolved puzzle. The young of the parasitic New Zealand Cuckoo, for example, start their migration long after their parents have left for the tropics. They are raised in the nests of foster

▲ FOUR OF SIX PANELS illustrating the principles of flight: an example of the many aspects of bird life that are presented graphically and synoptically in the new Sanford Hall of the Biology of Birds

parents, but the latter are sedentary and cannot show them the way. Nevertheless, the young cuckoos fly across several thousand miles of open ocean and unerringly find their winter quarters in Polynesia, on islands that are mere dots in the vast expanse of the Pacific. "Orientation by memory" and other simple explanations fail to account for this ability.

Many investigators are now trying to solve this puzzle. The results of some of their experiments are illustrated in one of the exhibition cases in Sanford Hall.

### Evolution

Special mention might be made of the section of Sanford Hall devoted to evolution in birds. It attempts to solve the question of the

origin of the various kinds of birds that populate our fields and forests. It was Darwin who gave the first constructive answer to this question, and it is no coincidence that Darwin found one of the chief inspirations for his broad evolutionary theory in a group of birds, the Galápagos Finches. To this day birds have provided some of the most instructive material for the study of evolution. The various steps that lead to the origin of new species are illustrated in Sanford Hall.

Evolution, according to Darwin, is made possible by three factors:

- (1) A great excess in the number of offspring over the parents.
- (2) Great variability among the individuals in a given species.
- (3) The struggle for existence

which favors the survival of the fittest.

Variability thus provides the material on which natural selection works. It is the keynote of a series of exhibits demonstrating the differences between individual variation (variation within a given bird population) and geographical variation (variation between populations from different localities). Individual variation is due to the fact that no two individuals in sexually reproducing species are ever completely alike, with the exception of identical twins. These variants are sometimes as different as the gray and the rufous phase of the Screech Owl or as the many variants of the Ruff.

Just as there is variation within a population, there is variation between populations. The Song Sparrow (*Melospiza melodia*), for example, has 33 geographical races in various parts of North America. These geographical races or subspecies intergrade wherever their ranges meet. Often they are conspicuously adapted to the environment. Races of the desert are pale and sandy in coloration, whereas those of humid regions are of a deeper, saturated tint.

Such geographical variation is by no means irregular. The races that live in more northerly, cooler climates are of larger body size than more southerly races (Bergmann's rule). Body appendages,

like the bill and tail, tend to be shorter in cooler parts of the range (Allen's rule). Pigmentation is increased in more humid areas (Gloger's rule). These ecological rules are illustrated in several exhibits in Sanford Hall.

So far, the exhibits have shown that species are variable, as Darwin had postulated, but how does this variation explain the origin of new species? This is shown in a series of maps, which illustrate how certain isolated geographical races eventually become so different that they are on the border line between species and subspecies. These are species in the making. If during this period of isolation such a population becomes genetically altered to the extent that it is no longer able to interbreed with the parental population, a new species is born.

The result of such speciation are groups of more or less closely related species. The North American warbler, genus *Dendroica*, is a spectacular example of such evolution. An exhibit shows that each of the eight species that occurs on Mt. Greylock in Massachusetts differs from the others in coloration, song, nest construction, and habitat preference. Speciation thus leads to an ever greater variety of organic beings in nature.

A trip to Sanford Hall is really necessary to appreciate the vast range of the exhibits it contains. Courtship and display, reproduction and egg-laying, parental care and feeding, birds and their environment are among the other topics presented in the effort to acquaint the student, as well as the layman, with the principal aspects of bird life. For anyone already interested in observing birds, the Hall will provide a broad background of understanding, and for one who knows little about bird life it would be hard to recommend a more stimulating introduction than these attractive, comprehensive, and skillfully designed exhibits.

◀ A GOLDEN PHEASANT and a Lady Amherst Pheasant, shown in flight

## The Hen

THE word "henpecked" brings to mind a picture of timid little men carrying umbrellas against their will. It does not seem to fit the rooster strutting in his flamboyant glory and crowing to high heaven. Throughout the animal kingdom, male animals usually have only the simple, primitive function of fertilizing the eggs, and among water creatures they often accomplish this merely in the general neighborhood of the female. Apart from this occasional activity, the male is free to go his way without further thought of his progeny, except perhaps to eat them if they happen along at the wrong place and the right size.

For the most part the males go their lordly way, eating, growing, fighting, occasionally mating. Some of their gaudy aggressiveness, however, may be due to there being too many of them. Among some animals, only the stronger, faster, or more glamorous run the best chance of securing a mate, and the rest, whatever their feelings about it, serve the kingdom mainly as fodder for others.

Pride goeth before a fall, and when we see what has actually befallen some males, it should be a warning to all others. The mildest penalty is paid by some fresh-water fishes, such as the bowfin, whose nest with its precious contents is guarded exclusively by the male. The female, in this case, is the one to wander away without further thought or care. Similar in effect but more humiliating in practice are the family duties of a small fish living in the Indian and Pacific oceans. The female lays her eggs in two bunches connected by a filament and then hangs them over a hooked, bony projection from the forehead of the male. The father-to-be is then condemned to swim about draped in this feminine garb

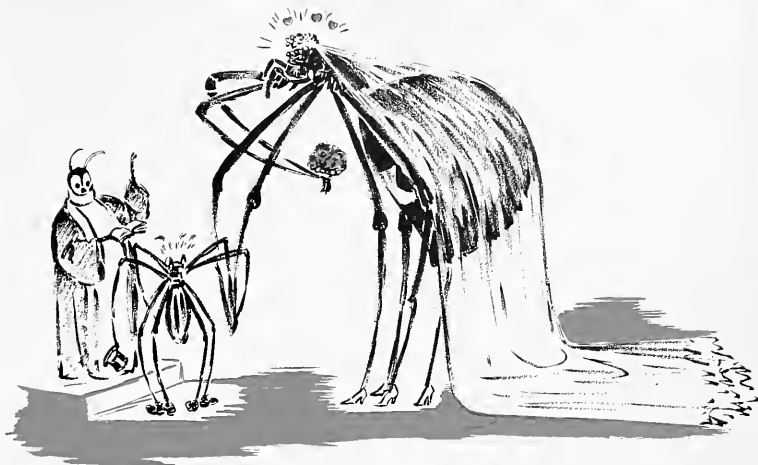


# Hencked Sex

Even Caspar Milquetoast would be a cave man compared with some of nature's benedicts

By N. J. BERRILL

Strathcona Professor of Zoology,  
McGill University



Drawings by G. Frederick Mason

until the young hatch and allow him to recover his self-respect.

The midwife frog of Europe is the father, not the mother. The female produces the eggs in chain arrangement, but the male deliberately takes them and winds them like a girdle around his legs and thighs. He then seeks confinement in some burrow until his term as a nursemaid is over.

These are mild discomforts, however, to those endured by certain other fishes and frogs. In most marine catfishes, the male carries the pea-size eggs in his large mouth cavity for weeks, even months, until they hatch. He loses his appetite and as far as is known goes without food for that period. Whether the little Chilean frog, *Rhinoderma*, is more or less a martyr is hard to say. The male is apparently able to eat during his servitude, but piping is inhibited by the eggs he carries in his vocal pouch. They stay there not merely to the tadpole stage but through metamorphosis, until they hop out of their father's mouth—small but fully formed frogs.

In the foregoing cases the importance of the male is really enhanced, and the loss of freedom as a paternal nurserymaid should not be considered disquieting when it is an accepted custom. Pipefish and sea horses have carried things further. In both of these weed-haunting

fishes the male lies close to the female to fertilize the eggs as they emerge; in the case of the sea horse, he actually curls his tail around his mate. The eggs do not float freely away in the water, however; nor are they attached, as many are, to the somewhat protective surfaces of rocks, weeds, or shells. Instead, they are passed to the male for safekeeping. The pelvic fins of the male alone are especially modified to form a brood pouch to receive them. Here the eggs develop until they eventually hatch and escape as miniature sea horses or pipefish, as the case may be.

## Femme fatale

From the male point of view, female scorpions and spiders are all too likely to carry matters much too far. A male scorpion may not have to risk death at the hands of a rival suitor quite the way certain other animals do, but he may pay with his life in the end anyhow. The female, after mating, has no further regard for the male; her predatory instincts override those of acquiescence, and she stings and devours the male, unless he is quicker than most of his fellows.

The orb-weaving spiders have the same nasty habit. The female will not respond to the male unless he makes timorous, tentative advances, and in some of the vagrant jumping spiders he has to put on a com-

plicated and spectacular performance comparable to the "love dances" of some tropical birds. During these dances the male spider remains at a safe distance and only approaches the female with great caution. If accepted, his danger after mating is just as great, and only his agility can save him. In the orb weavers, the male is sometimes many times smaller than the female—in fact, a dwarf. In one of the orb weavers, the female has a body two inches long, whereas the male is only one-tenth of an inch long. It has been suggested that the reduction in size is directly connected with the danger entailed during the mating season, on the grounds that small, active males have a better chance of escaping the ferocity of the female; but there seems to be no positive evidence to prove this.

It is possible to look upon a race or a species as having an existence of its own—an existence that overshadows the importance of any individual. On this basis, nature sometimes seems to operate for the economic efficiency of the whole. Males tend to consume food at the same rate as females, but collectively they do not contribute as much to the substance of the next generation. In such circumstances they are, to a large percentage, biologically superfluous.

Nature in the long run is apt to

be vigorously economical, even when appearing to be most wasteful. Accordingly, we find many instances where the males are greatly reduced in numbers by one means or another. Again, their life span is shorter. Among spiders, males are usually present in numbers equal to the females, but they mature more quickly (actually molt fewer times and live a shorter life.) They are specialists that are so constituted that they die soon after mating, with the result that they are not present to compete for the food supply after they have assured the next generation.

Most animals produce equal numbers of males and females. Modifications of the proportions are more often accomplished by some sort of selective mortality. Males and females of one of the large gill-bearing, fresh-water snails are produced in the same proportion, but the females live about three years, growing throughout and breeding each year, so that there are three generations of females alive at the same time. The males, on the other hand, survive only one breeding season and die in late winter. The effect is to limit the existence of large numbers of food-consuming males to that period when they are sexually valuable. That is, the male population is roughly but one-third that of the female.

Honeybees accomplish the same result by an inherited instinct. The worker bees kill off the drones at the beginning of winter and so conserve the resources of the hive for the benefit of more useful members of the society.

#### Inseparable

Dwarf males are the rule in several widely different groups of animals, and sometimes the male remains close to the female, so that whenever the eggs are shed, he is present to fertilize them. When he is held virtually in perpetual contact with a female, he tends to become parasitic, which may explain his reduction in size. The smaller he is, the less of a drain he will be on his mate.

In the case of the marine, worm-like *Bonellia*, the female is sausage-

shaped and about two inches in length, with a very long proboscis extending from the distal end. The adult male is a mere one-fifteenth of an inch long, though large enough to fertilize thousands of eggs. He swims about as a free individual for a short time, then settles on the proboscis of a female and creeps into her mouth and excretory ducts to spend the rest of his life in a special recess. The eggs are fertilized as they pass through the excretory ducts.

#### A Parasite on a Parasite

Among crustaceans, the female isopod *Bopyrus* lives in the gill chambers of certain shrimps and their more lobster-like relatives. This would be a difficult and awkward place for males to find her. Each female accordingly has a tiny but effective spouse living as a parasite between her leaflike posterior appendages. This is an interesting situation, because the female is parasitic on the shrimp while the male is parasitic on the female. Barnacles, typically crustacean for all their immobility, exhibit all possible sexual conditions, even within a single genus. Species of *Scalpellum* may have separately sexed individuals, may be all regular hermaphrodites (individuals having both male and female organs), or may be hermaphrodites with minute males, called by Darwin "complemental males." These are little more than bags of spermatozoa. They may be necessary to ensure cross-fertilization of the eggs.

These invertebrate animals are all remote from our own kind, and their peculiarities can be extremely interesting but rarely shocking. It is more startling to find a perfectly respectable vertebrate emulating them. In some angler fishes living in the middle depths of the oceans, the male is not only a diminutive dwarf but is firmly imbedded head-on as a parasite in the flesh of the female. One female caught near Iceland was forty inches long, whereas the attached male measured only about four inches. Another female, only two and a half inches, had a tiny male two-fifths of an inch long attached above the



right eye. Apparently the male, almost upon hatching, seeks the female and holds onto his selected mate for the rest of his life. There seems to be no preference for any particular part of the body; the abdomen, the region of the gill openings, or the sides or top of the head may be used. Occasionally, more than one male may fasten onto a single female. He grips her with his mouth, and his lips and tongue become completely fused with her skin. The mouth, teeth, jaws, gills, and fins of the tiny male all degenerate until he becomes a typical parasite. His blood vessels become continuous with those of the female, and he contains little more than the reproductive organs.

We humans have a kinship with fishes and still retain traces of that ancient aquatic ancestry. That such a fate should overtake a lordly male vertebrate is hard to accept with complete equanimity. However, we should realize that the creatures just discussed live mostly in the dark depths of the ocean, where the chances of a male finding a mate would be quite small if he didn't "tag onto her apron strings" early in life.

Perhaps the extreme in putting the male in his place is reached in several kinds of small animals which

are specially designed to live in temporary pools. The water fleas such as *Daphnia*, the equally crustacean ostracods, and the microscopic wheel-animalcules or rotifers have all evolved about the same method of "survival through sacrifice." Individually the males have "kept their self-respect." For the most part they are well-formed, active individuals. On the other hand, the male population has an intermittent existence that is anything but complimentary. As long as living conditions are reasonably good, no males are to be found. Each female produces successive batches of eggs that develop immediately without having to be fertilized by a male, and all develop into females. These in turn produce in the same way as soon as they are large enough to do so. Generation after generation is produced, and the community grows rapidly—entirely female.

In a sense the fate of the male individual seems less severe than that of the more or less parasitic dwarfs or short-lived males of other forms, for the males are not penalized in extent of development or in length of life. They normally do not exist at all, because the potential males hatch out as females.

Masculinity has been abolished but not the individuals that might have been masculine.

Here an entirely female world seems to be almost possible but never fully attainable in the long run, for in times of trouble males do appear. When females have begot females for so long that the population of the pond has become congested, or when sudden drops in temperature foreshadow the end of summer and the coming rigors of winter, a change occurs in the community. Some of the eggs that hitherto would have developed into females, develop into males. The emergency in some way calls forth a switch in the sex-determining machinery, and for the first time both sexes are present together, and eggs are fertilized. These eggs form hard protective shells, and when conditions go from bad to worse, as they usually do, the eggs survive like the seeds of annual plants and under circumstances fatal to their parents. Among the insects, aphids behave in essentially the same way.

#### Regeneration

There is one male animal, however, that really enters into the spirit of the thing. The Argonaut or Paper Nautilus is a small octopus

found in warm seas. Each sex has its own peculiarity. The female rises to the surface at the breeding season and lays her eggs in a unique and beautiful shell made by pressing two enlarged tentacles against her body and secreting lime. The male is a dwarf, though of moderate size. His spermatozoa are made into small packets within his body chamber. With one of his arms, which is especially lengthened and called the heterocotylus, he grasps numbers of these packets, swims alongside a female, and inserts the arm deep into her body chamber close to where the eggs will emerge. This is an act of chivalry that far outclasses Sir Walter Raleigh's, for he breaks the arm off at its base, leaving it within the female to liberate the packets as needed. But the respect that can be accorded such a self-sacrificing act is lessened by the fact that the little male can grow a new arm within a few months to replace the one he so freely gave away.

All in all, every conceivable means of suppressing the male as an individual or as a sex seems to have been tried by some animal or another. The female has dispensed with him for generation after generation and has made him a nursemaid. So perhaps it is somewhat surprising that for the most part the male has so often escaped all but the minimum of parental duties.



ANYONE who has thrilled to the song of the wind in Sierra forests, to Monterey's fog-swept poppy fields, or to the glory of sun-washed desert hillsides will find on a secluded ranch in Southern California's Puente Hills a scene to awaken a thousand reveries. Here the inspiration of a pioneer woman, implemented with 20 years of cooperative botanical effort, has compressed the very essence of the Golden State's 158,000 square miles into a 200-acre capsule.

Scientific test tube though it may be, the only frightening thing about this remarkable Orange County institution is its name—Rancho Santa Ana Botanic Garden of the Native Plants of California. Aside from this, everything about the place is as natural as moss on an alder tree. Even the most abysmal ignorance of perianth and pistil and other floricultural mysteries constitutes no barrier to its full enjoyment.

Established two decades ago by the late Susanna Bixby Bryant as a memorial to her father, the garden presents the world's largest collection of native California verdure—approximately 140,000 individual plants, shrubs, and trees, embracing more than 1200 species. In addition to the aesthetic and educational value of this semipublic park, its painstaking development has resulted in considerable new scientific knowledge.

Yet, because the Rancho has nothing to sell (not even an admission ticket!), its directors have made almost no effort to publicize it. Visitors were not encouraged prior to 1940, and the place was again closed to the public during the war.

So Rancho Santa Ana remains largely unknown not only to out-of-state visitors but to its immediate neighbors as well. The writer's own experience may be typical. Our family had been lifelong nature lovers and had lived within an hour's drive of the Rancho for 25 years, yet last spring was the first time any of us had visited the place!

In Southern California, where land changes hands more rapidly than in most other parts of the



*Photo courtesy Rancho Santa Ana Botanic Garden*

# Rancho SANTA ANA

Here, in Southern California, the floral  
tapestry of an entire state is compressed  
into a horticultural wonderland

By NELL MURBARGER

world, even the history of Rancho Santa Ana is exceptional. Throughout nearly 140 years, its title has been vested in but two families!

Portola's desert-weary expedition first glimpsed the green valley of the Santa Ana River in 1769. Forty years later the King of Spain granted to a member of that party—Don Jose Antonio Yorba—a generous portion of the rich bottom land and the rolling hills adjacent. For the next half-century, Don Jose, and later his son Don Bernardo, reigned over this sweeping empire as benign feudal barons, their castle a 70-room adobe hacienda. Not until seventeen years

after Don Bernardo's death was any portion of the Yorba ranch permitted to pass from family ownership.

In 1875, heirs to the Yorba estate agreed to sell a substantial acreage to John W. Bixby, newly arrived from Maine, who foresaw in California a mighty agricultural state in the making. For all his Yankee shrewdness and business acumen, John Bixby was throughout his short life an impassioned lover of nature. His daughter, Susanna, though but a small child at the time of her father's death, often recalled in later years that she could not remember his ever



◀ **PLANTING BEGUN** and the Administration Building and Assembly Hall completed. The bald, rugged range of the Santa Ana Mountains is seen in the background

returning from the fields without bringing to her mother a bouquet of whatever wild blooms the season afforded. Largely because of this childhood memory, Mrs. Bryant decided upon the botanic garden as fitting memorial to her pioneer father—a young visionary, full of courage but never too busy to appreciate natural beauty where he found it.

Like everything connected with the development of the project, its location was settled upon only after extended consideration and long-range planning. Eventually, a 200-acre tract in the heart of the huge Bixby holdings was selected, in the northeast corner of Orange County near the San Bernardino County line. Ranging in elevation from 450 to 1100 feet, it offered a view of snow-crowned Mount San Jacinto to the east and the blue waters of the Pacific 23 miles to the southwest.

Nothing about the site was then remotely suggestive of a botanic garden. Not a shrub or tree grew upon its bald, brown hills, only soft, gray coastal sage and other small herbage. It was a commonplace California pasture land upon which cattle had ranged for 115 years. In that pasture land, however, the technicians engaged by Mrs. Bryant saw an unparalleled selection of exposures, moisture conditions, and varied types of soil—87 types, according to chemical analysis, running the gamut from heavy clay to sandstone outcroppings.

With ample funds for the development and maintenance of the virgin site, botanists, soil experts, authorities on irrigation problems, and other technicians in all phases of land husbandry were called on to determine how the land should be planted in order to utilize to the fullest its potentialities.

► **TOWER** of the Administration Building as seen from the cactus garden

Inducing the lion to lie down with the lamb might have been a relatively simple task compared with some of the difficulties surmounted at Rancho Santa Ana during the ensuing 20 years. Plants, perhaps more than any other form of life, are slaves to environment, to specific elevations and certain types of soil. How to make one canyon acceptable to *Washingtonia filifera*, the wild palm native only to the hottest sections of the Colorado Desert, while an adjacent ridge presented every appearance of an evergreen forest high in the Sierra—that was the question but in a thousand forms.

To what degree such posers have been solved is best determined by a personal visit.

Throughout April and May, when the blossoming season is at its peak,

each Friday and Saturday find the Rancho open to the public by admittance card. Issuance of such passes is not restricted to State Senators and other visiting celebrities; anyone interested in nature and the out-of-doors may obtain one by addressing a written request to the Rancho, Route 3, 23531 Esperanza Road, Anaheim, California. In his application the potential visitor should state what day he wishes to visit the garden and how many persons will comprise his party. Further (and this is important!)—a stamped, self-addressed envelope should be enclosed. There is no other cost.

With each admittance card is mailed a simple chart for locating the place—an indispensable aid, since the Rancho is indicated on few highway maps or road signs.

Photo by M. & M. Carothers



Following the printed chart, we wound our way past groves of oranges, English walnuts, and avocados and down quiet back-country lanes bordered by towering eucalypti, pepper trees, acacias, and palms. Gradually leaving behind the orchards and small farms, we entered a land of dry, rolling hills, partitioned by barbed-wire fences, ranged by cattle, and spotted by clumps of native cacti.

Twenty miles east of Santa Ana, the Rancho road veered to the left from the public road and for the next several miles threaded its way between two long rows of pomegranates. This is said to be the longest lane of these trees in all North America. Vividly accentuating the glossy, dark green of the foliage was a mantle of scarlet trumpets, which autumn would change into equally scarlet globose fruits.

Passing boldly through several ranch gates fortified with "No Trespassing" signs, we finally rounded a bend in the arid hills and found our destination at hand.

First stop upon entering the garden was at the sycamore-shaded picnic area. There an attendant collected our pass, supplied us with a free guide map, and in-

formed us that thenceforth we were on our own, with five miles of winding auto road and twelve miles of secluded foot trails at our disposal.

"Go wherever you like," he suggested pleasantly, "only be sure to take the Skyline Drive before you leave . . . and have a nice time!"

No sooner had we left the picnic ground than we found ourselves in an altogether different world from the one through which we had passed en route to the Rancho. Here was an open green meadow, as densely blanketed in wild flowers as ever were the fog-drenched hills of Marin County or the hot slopes of Kern—a Joseph's coat of golden poppies, blue lupine, white primroses, and mauve godetias, those tissue-petaled Farewells-to-Spring.

Remembering what the attendant had said, we reluctantly pulled ourselves away from the colorful meadow and again headed up the winding scenic grade. But not for far! Within a mile we had yielded to the lure of an enticing side trail!

Leaving the car in one of the frequent pull-outs along the road, we shouldered our cameras and set forth adventuring afoot. Before we had put a dozen yards behind us, we found it all but incredible that

the forest which engulfed us could be the product of only 20 years' time!

In the presence of these trees, one of the family took advantage of the occasion to remind me of my "forest." I had one day planted an acorn beneath my bedroom window. It sprouted and eventually grew into an oak—but not a "great oak" by any means! After six years of pampering, it still was only a reedlike whip, eighteen inches tall, when I pulled it up in disgust and consigned it to the compost heap.

Yet on these hillsides, so recently grassland, were growing tall pines and Sitka spruce and fir. On the ground lay a brown carpet of needles, and through the treetops sighed a lonely little wind. I could have sworn that I last heard that wind near timberline in the High Sierra!

As we wandered on through this strange world of enchantment, we found oaks and cypresses—fourteen species of the latter, we were subsequently informed. Here, too, were box elders and buckeyes, bay laurel and sequoias—both the Big Trees of the Sierra and the redwoods of the coastal belt.

With a tug at our hearts we found ourselves face to face with a thicket of redbud, an old friend we had not encountered since that memorable summer spent tenting in the gold mining country along the Feather River. And over here was another good friend, the *madrona*, Bret Harte's Captain of Western Wood. How was it the poet had expressed it? . . .

*Never like thee tree arrayed,  
O, thou gallant of the glade!*

And here was a whole glade—200 of them!—their trunks as satiny-red and marble-smooth, their thick leaves quite as glossy as any that ever grew in northern woods.

Here we saw shrubs whose name we had never learned—those we had always called "the yellow-flowered shrub at Uncle Jim's or

Photo by Nell Murbarger



◀ TWELVE MILES of enticing foot trails wind through the forested slopes and valleys of Rancho Santa Ana Botanic Garden



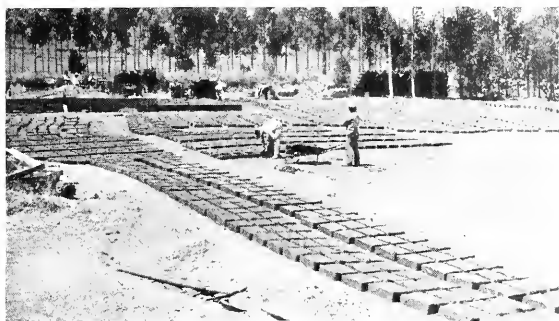
▲ A CATTLE RANGE for 115 years, these semidesert hills, dressed only in gray coastal sage, were chosen in 1927 as the site for the botanical experiment

"that ferny-leaved bush that grew along the rimrock." Here they were properly introduced to us by inconspicuous metal name strips at their base.

On and on we wandered. The sun passed its zenith, but the attractive picnic ground and well-filled lunch hamper in the car were quite forgotten as we reveled in one discovery after another. There was no sensation of restriction, of being in a planned park or even in the heart of a busily-working ranch. Rather, our feeling was one of complete remoteness in mountains distant from any center of population.

Not until considerably later in the day did we complete our tour of Skyline Drive and return to headquarters. There we barely had time for a hurried inspection of the wild flower display in the assembly hall before the audience began assembling for the talk given each visitors' day by Dr. Philip A. Munz. After 27 years in the Department of Botany at Pomona College and 2 years at Cornell University, Dr. Munz accepted the post of Rancho botanist in 1946.

Too friendly and informal to be tagged with the pedantic-sounding



▲ HAND-MOLDED ADOBE BRICKS, shown here during the drying process, formed the basic material of the Administration Building. The bricks were made on the premises by Mexican laborers, many of whom had been employed as ranch hands by John W. Bixby a half-century before

➤ THE ADMINISTRATION BUILDING nearing completion. The barrenness of the surrounding hills is still very much in evidence



label of "lecture," the noted botanist's talk on this occasion dealt with medicinal properties of various California plants and the uses to which each was put by the early Indians and Spanish-Californians. A different subject is covered each day during the visiting season.

In conclusion, Dr. Munz invited questions from the audience. And what a barrage was flung at him! "What native shrubs will do well on the north side of my house, where they won't get any sun?"

"What trees grow best in heavy clay soil?" "What plants should I use to check erosion and beautify an unsightly cliff overlooking the ocean?"

With the meeting at an end, we continued our inspection of the indoor flower exhibit, consisting of perhaps 150 individual arrangements, one for each plant then blossoming at the Rancho. Each species was tagged with its name, habitat, and other particulars of interest.

En route to the cactus garden on

*Photos courtesy Rancho Santa Ana Botanic Garden*



➤ ADMINISTRATION BUILDING from the south side

RANCHO SANTA ANA



Photo by Nell Murbarger

a well-drained, sunny promontory a few hundred feet east of the assembly hall, we had an opportunity to inspect the Administration Building, a structure in early Californian architecture, quite noteworthy in itself. It is built entirely of native adobe except for one wing of fireproof concrete, housing a valuable library of some 3000 carefully chosen volumes of botanical and historical interest, as well as many exceedingly rare pamphlets and papers. The handmade bricks used in its construction were molded and laid in 1927 by venerable Mexicans, happy for this chance to assist in furthering a memorial to the beloved young *patron* who had employed many of them on the ranch nearly a half-century before.

In addition to the executive offices, the Administration Building houses an herbarium totaling more than 31,000 mounted flower specimens, with hundreds more waiting to be mounted when time permits. Thick-foliaged types, such as cacti and other succulents, not lending themselves readily to dry mounting, are "pickled" in liquid and stored in glass jars—300 of them. There is also a large collection of seed samples and woods, a photographic darkroom, and a file of nearly 6000 photographic negatives available to students and other interested persons.

This Administration Building was for several years the personal residence of Mrs. Bryant, who shortly

◀ A RESTFUL RETREAT beneath the pines, overlooking the Santa Ana River Valley and the rugged, canyon-cleft hills beyond

before her death in 1946 set up a generous endowment fund to assure perpetual maintenance of the garden and furtherance of its work and aims.

Elsewhere on the 200-acre tract are located the nursery, greenhouses, lath house, and potting shed with soil sterilizer and electrically-heated cold frame. Many pounds of seed are harvested each year from seed-bearers in the garden, some being retained for Rancho use, the remainder distributed to other botanical institutions, municipalities, and parks, along with many thousands of cuttings and small plants started in the Rancho nursery.

While all lovers of nature are welcome to enjoy the garden, Dr. Munz took special care to point out that Rancho Santa Ana is not a public recreational park in any sense of the word. "Rather," he said, "it was established to promote better understanding of California's native flora, its interest, use, and conservation."

In this connection he cited a portion of the memorial's Declaration of Purpose, as set forth at the formal dedication in 1934:

"... An institution founded primarily for scientific research in the

field of local botany . . . to preserve the native California flora, to replenish the depleted supply of some of the rarest plants which are rapidly being exterminated, and bring together in a comparatively small area as complete a collection of the rich store of native California plants as can be grown in the southern section of the state . . ."

Throughout the 20-year life of the garden, even when the prescribed course was far from smooth, this avowed purpose has stood like a beacon. One of the more difficult problems met and surmounted during that early struggle was the laying of irrigation pipe lines over steep-sided hills and through, deeply-cut canyons—a terrain far better suited to cruising buzzards than to water mains.

With the starting of planting operations and the opening of trails and roads, erosion likewise became a serious matter. Where exposed banks were cutting most drastically, the situation was brought quickly under control by the strategic placement of brush that had been cut or grubbed out and branches that had been pruned. These brush slashings, when thrown on eroding areas, catch small debris, mud, leaves, and dead grass carried by rain water, forming a loose dam to retard the torrents of water. At the same time, the long-range answer to erosion was supplied by well-chosen plantings of quick-root-

Photo by Nell Murbarger



➤ LESS than 20 years ago this scenic pine-bordered "mountain drive" was naked pasture land

ing and drought-resistant shrubs, such as *Baccharis* and cypress.

In certain sections of the plot, the soil proved to be so unusually heavy that special treatment was necessary before tree planting could proceed. Holes blasted in the clay and refilled with lighter soil solved the problem. For shallow-rooted plants, this same heavy clay was brought into satisfactory condition by liberal applications of sulphur, manure, and organic matter.

Even when all else was at least partially under control, there was always the problem of pests. Bands of deer wandered down from the higher ranges adjacent to the Rancho and found special delight in feeding upon saplings and exotic shrubs. Field mice and jack rabbits made war on the large, flat lobes of the prickly pears; heavy soil and gophers worked havoc on the *Calochortus*; and construction of a new road eliminated the bulb garden altogether. Flea beetles appeared on the godetias; scale and psyllids on the *Rhus*; *Phytophthora* attacked the madroñas.

The leafy succulents—particularly *Dudleya*, *Stylophyllum*, and *Sedum*—were persistent objectors to their newly enforced habitat. On the one hand, they could not withstand open exposure to Southern California's intense summer sun; on the other, they could not endure moisture in any great quantity. The ferns, *Woodwardia* and *Pteridium*, were perhaps unhappiest of all, but even these are responding satisfactorily as increased tree growth brings denser shade to the portions of the garden in which they are planted.

Some of the Rancho's most troublesome times followed the outbreak of war. With many of the more skilled employees leaving to join the armed forces or to enter war production plants, the garden was left dangling in mid-air. Shortages of both personnel and materials were so serious that for five years almost every effort beyond actual maintenance was out of the question.

In the midst of these dark days came the greatest blow yet experi-

enced—the disastrous fire of November, 1943. Racing down Santa Ana Canyon, fanned by a high wind and leaping hundreds of feet at a bound, the catastrophic blaze swept through the Rancho, ravaging nearly one-third of all the plantings made up to that time. But despite these difficulties, scientific research has gone on unflinchingly and with some highly commendable results.

The most ambitious single project at the Rancho has been intensive work in the field of Southwestern cypresses. For California uses there is probably no more desirable type of tree for hedges and windbreaks than the Monterey cypress. Once widely cultivated over the state, recent years have found the Monterey species seriously depleted as a result of canker or *Coryneum* fungus. Dr. Carl B. Wolf, head botanist at Rancho Santa Ana from 1930 to 1946, when he was succeeded by Dr. Munz, interested himself especially in this genus, seeking some other variety that for windbreak purposes was as satisfactory as the Monterey cypress and at the same time immune to the fungus.

With the co-operation of Dr. Wagners of the United States Department of Agriculture, a long-range program of study was launched, 7500 seedlings being used in test plantings widely distributed over the state. These included 72 different strains of trees, comprising 15 species or subspecies.

This and other studies are still being conducted. Discoveries of botanical importance are being made constantly, and reports dealing with developments at Rancho Santa Ana are finding their way into universities and scientific institutions throughout the civilized world.

While the Rancho naturally attracts many persons of a scientific bent, it has been kept notably free of any scientific "heaviness." No one need feel overawed or "beyond his depth" in its presence, for here

► DR. PHILIP A. MUNZ, botanist at the Garden, surveys part of the grounds from a massive window in the Administration Building

is a place where every man may absorb as much as he is capable of absorbing.

Audubon Societies come here to study birds; high school teachers bring their botany classes; and garden and nature clubs hold their annual picnics under the sycamores. Boy and Girl Scouts and Campfire Girls find the place ideal for required nature study and hiking practice, and photographers make it a rendezvous for special "shots" of flowering yuccas and cacti.

And then, of course, there are those of us who have no practical excuse for visiting the Rancho except that we have long retained in our hearts a warm spot for Other Places and Other Times. Here, in a single afternoon, we may renew acquaintance with hundreds of old friends of forest, desert, and meadow.

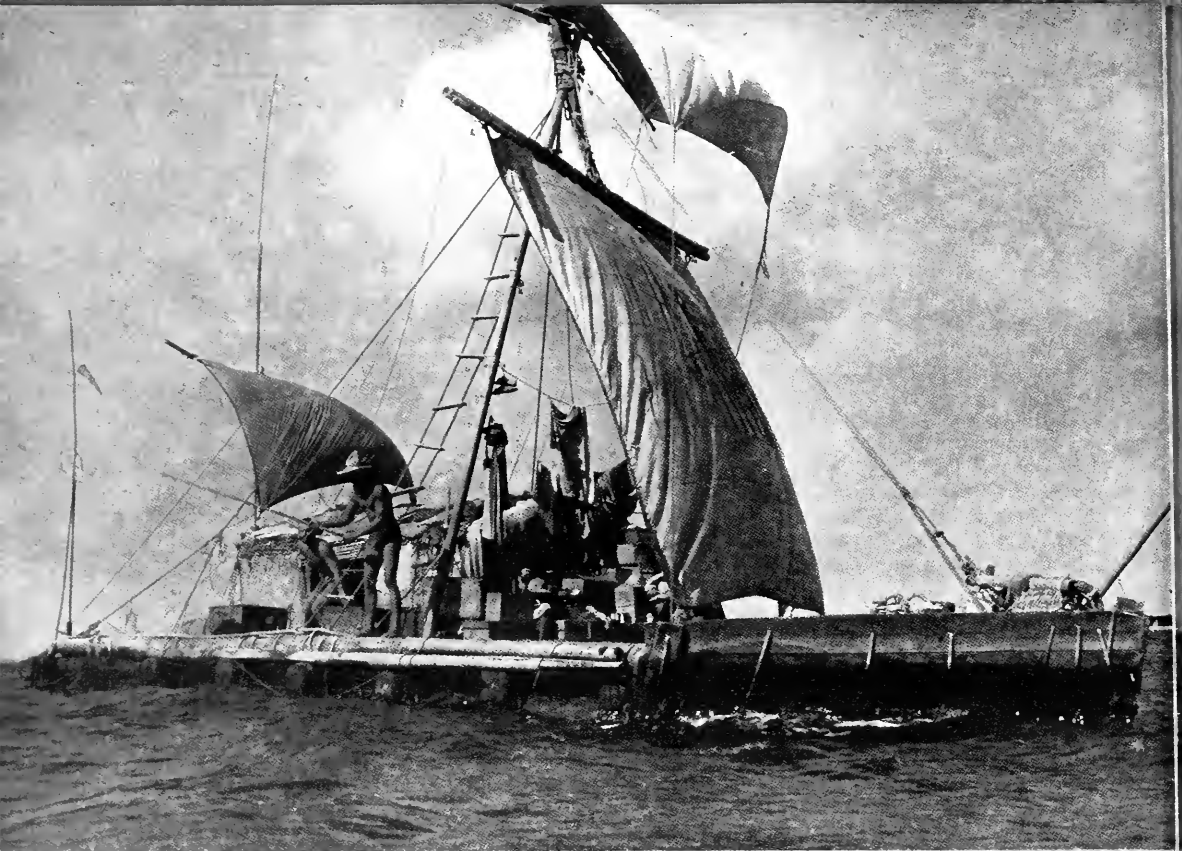
All this because of a woman's dream. Before her death in October, 1946, Susanna Bixby Bryant saw her long-planned garden an established fact. While plantings were young and incomplete and much still remained to be accomplished, she had at least the satisfaction of knowing that wealth taken from the productive land by her forebears was being returned to that same land in such a manner as to benefit mankind for generations to come.

Surely no one ever devised a more fitting memorial to a nature lover.

Photo by M. & M. Carothers







▲ BOUND FOR POLYNESIA, the "Kon-Tiki" plows westward into the open Pacific. One of the crew is fishing

#### EDITORIAL FOREWORD

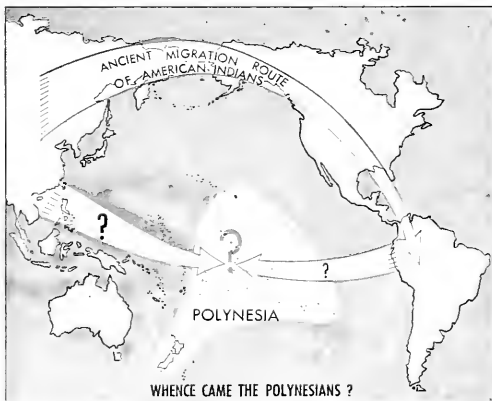
*Authorities generally agree that the ancestors of the American Indians came from Asia by way of the Aleutian Islands or Bering Strait. The earliest of these people may have come as much as 20,000 to 40,000 years ago. But up to 1500 years ago the vast island domain of the Central Pacific known as Polynesia apparently remained uninhabited. There seem to have been two migrations into these islands, one perhaps around A.D. 500 and the other around A.D. 1000.*

*The question of where these Polynesian people came from has long occupied the attention of anthropologists. Obviously they must have come either from Asia or America. Almost all specialists in this field of science have considered it more likely that they came from Asia.*

*The present article is written by a man who, after several years of study including approximately a year in Polynesia, a year among the Indians of the Northwest Coast, and many months in South America, became convinced that the Polynesians came from the American side of the Pacific. So firmly did certain cultural similarities lead him to this theory that he resolved to duplicate this long voyage from Peru to Polynesia with the same primitive equipment that the Peruvians are known to have had prior to the first European contacts. The present article is the story of this voyage.*

*Neither the author nor the editor would have felt it within the scope of this article to present or evaluate the various complex arguments bearing on this migration riddle. The author has assembled his own arguments in a sizable book, which will be published within a few months, and there they*

*will be judged by scholars on their own merit. Here we have opportunity to see, as if at firsthand, the actual problems that would have been met by a group of prehistoric Peruvians if they embarked or were cast adrift on one of their large rafts. As such, the voyage of Mr. Heyerdahl and his five companions provides new information on one of the significant aspects of this question, and it can be considered one of the most enterprising expeditions of recent years.*







◀ A THATCHED JUNGLE DWELLING of bamboo made an ocean home for the Norwegian explorers on their raft. From left: Watzinger, Haugland, Raaby, Danielsson, and the author

▼ THE LANDLUBBERS became experienced seamen as they took turns day and night at the steering oar to hold the stern to the sea and wind. Expedition leader is helmsman here



# The Voyage of the Raft "KON-TIKI"

An adventurous inquiry into the origin of the Polynesians

By THOR HEYERDAHL

"Kon-Tiki" photos from Black Star

USUALLY men who have embarked on an ocean raft in modern times have been shipwrecked sailors whose sole desire was to escape the perils of the open sea and reach the nearest coast. But this was not the case in April of last year, when the tugboat "Guardian Rio" towed a clumsy raft away from the sheltered docks of the Peruvian port of Callao and left it adrift well outside the harbor entrance. The six of us that were left aboard the raft were filled with one single hope—that the wind and current would push our primitive craft far away from the South American mainland and right into the wide-open span of the vast Pacific Ocean.

Our purpose was not to flee the Republic of Peru. Leading officials of many nations had bidden us

hearty farewell at the dock as the Peruvian Navy tugged us to our point of departure. Nor did we possess any desire to establish a world record in hazardous ocean drift. Yet the betting went high at the docks when we left.

Some claimed that we would be picked up off the coast in a few days or would never be seen again. The nine logs of porous balsa wood upon which we floated were too fragile and would break asunder in the heavy coastal swells, or they would at least be waterlogged and sink underneath us far short of the halfway mark to Polynesia, whose nearest islands lay some 4000 miles from Peru. With a foot and a half of freeboard at the highest section of the bamboo deck, and with an open bamboo hut with thatched roof as our only shelter, we would

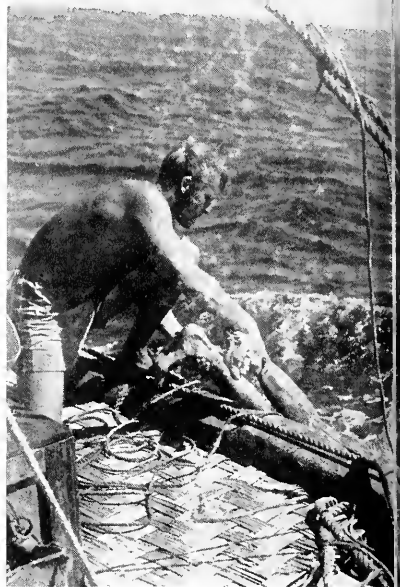
be at the constant mercy of the waves and the weather and be lost in the first storm.

Others claimed that ropes were no good in the tropic sun and in the sea water and that the complete absence of nails, pegs, and wire in our raft would allow it to tear to pieces as soon as the constant movements of the logs started to chafe the hemp-rope lashings. And if a balsa-wood raft, against all the warnings of the experts, should prove to be seaworthy, it would still not be navigable with its clumsy, square sail and primitive steering oar. How, then, could we possibly expect to hit one of the tiny, farflung islands? The distance ahead was twice the journey of Columbus and the clumsy raft not even comparable.

All these sinister but well-meant



▲ SHARK AND TUNA were part of the day's catch. The voyagers learned that primitive raftsmen would never have starved on a drift across the East Pacific. Shark, caught chiefly as a safety measure, was edible if correctly soaked before cooking



▲ DIVING IN SHARK-INFESTED WATERS required a good grasp on the ankles. Ever underwater lashings on logs and centerboards had to be examined regularly for fear of chafing

warnings were haunting my mind the first night after the last smoke of the tugboat had dissolved behind the horizon. When I was relieved from watch and tried to sleep, I realized how everything was in motion, not so much the pitching and rolling, as the restlessly undulating movement of the bamboo matting on which we lay on top of the great logs. Each time the stern was lifted by the seas, I saw dancing black hills of water, silhouetted against the stars as they chased along both sides of our raft, with whitecaps hissing at us as they passed. I listened to the squeaking and gnawing of a hundred ropes and the splashing and hammering of water everywhere. At regular intervals heavy seas thundered on board astern, but I noticed with comfort how the water, after whirling up to the waists of the two steersmen, instantly dwindled by falling between the open logs or over the sides of the raft. The seas fell in a pit before they could reach the unprotected bamboo hut lashed on deck a few feet from the stern. Therefore, we struggled to hold the stern to the weather and never let the seas in from the sides.

Gradually I felt happy and proud of our peculiar craft. But I could not quite get away from the compelling music of all the light and

heavy ropes as everything aboard moved slowly up and down and even sideways as far as the ropes would permit.

What would the future bring us? How would the raft behave after a week, a month, or perhaps a year at sea?

I was not a sailor, and only one of my companions was experienced in handling an ordinary boat at sea. I had not been able, word by word, to answer the pessimistic warnings of naval authorities and other experts before we put out to sea. I was, nevertheless, firmly convinced that our raft could float across the ocean and bring us safely to some distant Polynesian shore. The secret of my stubborn confidence was that I felt certain that this same ocean route had been covered before by prehistoric men on the very same type of craft.

Already in 1937, after leaving the University of Oslo, I had made a zoological-ethnological survey on the lonely Marquesas Islands in the Southeast Pacific. What I found led me to suspect that an influence from early Central or South America had somehow preceded the present Polynesian culture in this area. It is well known that a number of striking similarities in the culture of South America and Polynesia have been noted. These in-

clude two of the important cultivated plants—the sweet potato and the bottle gourd—and many cultural features. The theory has therefore frequently been advanced—and again as frequently rejected—that there must have been a prehistoric contact between these two areas.

There can be no possibility of any land bridge having existed in human times, for a comparative study of the animal life of Polynesia proves its hoary isolation. The island people, when first discovered by Europeans, possessed good seagoing canoes, whereas the natives of Peru had only clumsy balsa rafts for their coastal navigation. Because of this, it has usually been assumed by the few who believe there was a cultural transfer that the South American cultures were influenced by the island people rather than vice versa. This view has never been fully accepted and is even doubted by competent scholars of the present day. It is too

obvious that some of the Peruvian constructions, artifacts, and food plants in question date from an earlier period in America than A.D. 500, which is commonly accepted, through comparative genealogy, as the approximate date when the first Polynesians spread into the East Pacific.

Thus I had found myself inescapably drawn toward the alternative theory to explain the striking parallels between Peru and Polynesia—namely, that an offshoot from the amazing cultures of early Peru drifted, intentionally or otherwise, into the Pacific.

I was instantly met by one killing argument: How could the Peruvians have covered the thousands of miles of intermediate ocean when their only means of navigation in prehistoric times was an open balsa raft?

To me, there was only one satisfactory answer, and that was to build such a balsa raft and see if it could survive this journey.

I selected five dependable men who volunteered to join me on the experimental voyage. One of them, Herman Watzinger, was a technical engineer, and he directed the building of the balsa raft, guided by detailed accounts and sketches left in the earliest records after the conquest of Peru. First we had to get into the heart of the Ecuadorian jungle to find present-day balsa trees that would match the dimensions of the prehistoric rafts. We cut down nine giant trees, and floated on them down a jungle river to the Pacific coast. With the blessings of the President of Peru and his Naval Minister, the prehistoric type of craft was built in the main naval harbor of Callao under our own supervision.

The nine balsa logs were lashed together side by side with many separate pieces of hemp rope. The bow of the raft took an organ-pipe design, with the longest log in the middle measuring 45 feet and projecting beyond the others both in the front and in the stern. In the stern it supported a big chunk of balsa holding tholepins for the steering oar. Of the two-foot cross section of these logs, more than



▲ IN THE WAKE OF A GALE: the raft rolling through heavy swells. The lookout was watching the cameraman, who was being towed in a tiny rubber float

half was submerged in the water, but nine smaller crossbeams of light balsa covered with bamboo lifted the highest portion of the deck (including the floor of the open hut upon which we slept) eighteen inches above the sea. The little plaited bamboo hut with thatched roof; two hardwood masts side by side, with a square sail; five centerboards two feet wide and six feet deep, inserted at irregular intervals between the logs; and a long wooden steering oar astern completed our replica of the colorful prehistoric craft.

We named our raft "Kon-Tiki" in honor of the mythical sun king who the Incas claim built the enormous stone constructions near Lake Titicaca before he was defeated in war by local tribes. After the de-

feat, according to legend, he fled with his light-colored people down to the coast and then westward into the Pacific Ocean, never again to return to Peru. Throughout the Polynesian islands, Tiki is remembered as the mythical hero who was first in the line of aboriginal chiefs to settle the islands and to claim direct descent from the sun. The Peruvian prefix "Kon" means Sun.

The six of us went aboard on April 28 and were left at the mercy of the elements in the old Inca fishing grounds outside the port of Callao. Our ages ranged from twenty-five to thirty-two. Herman Watzinger, second in command, was in charge of testing and hydrographic and meteorologic measurements. Erik Hesselberg, an artist,

was responsible for plotting our drift. Our radio operators were Knut Haugland and Torstein Raaby, both famous for their sabotage activities during the recent war (instrumental, respectively, in the important sabotage of the German Heavy-Water Plant and the battleship "Tirpitz"). Bengt Danielsson, lonely Swede on our Norwegian expedition, was an ethnologist from the University of Upsala who joined us in South America after an expedition in the jungles of Brazil.

Our voyage would carry us through a vast span of ocean that was very little known, since it was outside all the usual shipping lines. We had therefore been requested to make continuous observations and transfer them via the amateur radio network to the United States Weather Bureau. But unless we should use the radio for calling help, it would not alter the primitive conditions of our experiment in any way.

The first weeks at sea were hard. One man was seasick for several days and confined to the hut; consequently, with the ocean breaking over us, two of us at a time constantly had to battle with the clumsy steering oar, trying to hold our stern against the short, racing seas of the Humboldt Current. We were soon caught by the offshore trade winds and were then only able to sail before the wind. We now realized that we had cut all our bridges and that there was no road back to the coast.

We had been at sea only a couple of days when an airplane flew out to bring us a last farewell. We never saw the plane (our horizons were narrowly fenced in with watery hills on all sides), nor did they see us, but we spoke to them for several hours with our little radio.

After the first weeks we came into calmer seas with long, rolling swells. The great blue ocean was dotted with whitecaps, and trade wind clouds drifted across the blue sky. We had soft days with swimming and rest, and we traveled along in comfort. Our drift turned from northwest to west as we left



▲ TIGHTENING A LOOSE STAY to keep the heavy mast from falling. There were no nails or wire in the prehistoric type of craft

the green and cold Humboldt Current and entered the blue and increasingly warm South Equatorial Current. We made as much progress as 72 miles in one day, with a daily average of 42 miles for the entire voyage. The surface drift exceeded the current drift and occasionally blew us out of the main sweep of the central current.

We found little wearing on the ropes and learned the reason why. The balsa was too soft to chafe them. In case of friction, a rope would soon work itself into the waterlogged surface of the balsa logs and thus remain protected. It was more discomfiting to observe that splinters cut from the surface of the logs had become waterlogged and sank when thrown overboard. It had been common opinion in Peru that the logs would be completely submerged before we sighted the islands.

Archaeologists no longer doubt that the prehistoric Peruvians used sails: Not only are there good historical descriptions of rafts equipped with sails, but centerboards of late pre-European date have been found. Our testings with centerboards clearly proved that they are useless on a raft if it is merely paddled or carried along by the current.

The first real excitement we ran into after entering the South Equatorial Current was the largest monster of the seas—the rare but famous whale shark. Accompanied by a shoal of pilot fish, this giant among all fishes slowly caught up with us from astern, and the water splashed around its enormous, white-speckled back as though on a small reef. The fish bumped into the steering oar and placed its huge, froglike head, with tiny eyes and a five-foot mouth, right up against the raft. The whale shark has been measured to a length of 45 feet and undoubtedly grows larger. We would never have dared such an estimate, but while the head appeared on one side of the raft, the tail simultaneously appeared on the other.

The whale shark kept us company for several hours, and the excitement on board was great, with everybody prepared with spears, hand harpoons, and motion picture camera. The peaceful visit ended when the excited navigator ran his harpoon with all his strength down between his legs and into the cartilaginous head of the monster. During the terrific commotion the whale shark dived, broke the harpoon, snapped the rope, and disappeared.

Only at one other time were we visited by what we suspected to be whale sharks. It was during a fairly calm night when three immensely large and phosphorescent bodies swam in circles under us. But occasionally we ran into schools of whales. The huge, snorting animals rolled right up beside us without the slightest fear. They could have splintered our raft with a single blow of their mighty tails, but after an exhibition of their swimming ability, they left us behind.

Some 600 miles southwest of the Galápagos we were twice visited by giant sea turtles. One was under constant attack by a dozen furious dolphins which tried to snap at the turtle's neck and fins. After sighting the raft, the turtle made its way right up to our side but swam away as soon as it saw us. Three of our men, equipped with rope, pursued the turtle in a tiny, inflatable rubber float, but our visitor escaped while the bewildered dolphins concentrated all their attention on the bouncing little float.

Weather permitting, we often got into our rubber float, two or three at a time, and took a "vacation" from our sturdy log raft to study our craft from a distance. We could imagine the sight that early Peruvian seafarers must have had when they sailed their flotillas of rafts side by side along the coast—or into the ocean like Inca Tupac Yupanqui, who according to legend discovered some East Pacific islands before the Spanish Conquest. Particularly at night, we experienced an unforgettable sight. Night-black seas, billowing on all sides, and twinkling stars formed our entire world.

The year 1947—A.D. or B.C.—what did it mean? We were at least alive. Time had little meaning; we were lost in the endless dark. Ahead of us "Kon-Tiki" rose and then sank between the seas. In moonlight there was an unbelievable atmosphere around the raft. The huge, wet logs fringed with seaweed, the square contour of the sail, the bushy jungle hut with a petrol lamp astern looked like something cut from a fairy tale rather than from

reality. Now and then the raft would disappear entirely behind the black sea; then, with water pouring from the logs, it would rise high to be silhouetted against the stars.

Although we spent 101 days and nights drifting on our raft, we never sighted a ship or any floating debris left by mankind. If a ship had crossed our path during an average day at sea, it would have found us slowly dancing up and down over great rolling swells dotted with minor waves that were stirred up by the trade winds, which constantly blow from the New World into the island domain. A tanned and bearded man, devoid of clothing, would have been sighted at the stern of the raft, either desperately struggling with the ropes of a long steering oar or, if the wind were steady, sitting and dozing in the sun. Bengt would be found on his stomach in the doorway of the hut reading one of his 73 sociological books. Herman would be seen busily occupied anywhere, at the top of the mast, underneath the logs, or running around with instruments to measure wind and water. Knut and Torstein were always

struggling with the weather-beaten radio sets, repairing damage and sending our reports at night to the amateur stations that could hear our signals. Erik was always mending sail and splicing rope and sketching fishes and bearded men alike. And each noon he grabbed his sextant and gazed at the sun to determine how far we had moved since the day before. As to myself, I was writing logs, collecting plankton for food experimentation, and fishing or filming.

The day started with a glorious sunrise over the sea, the cook being relieved by the last night watchman to collect the flying fish that had flown on board during the night. These were fried on a small primus stove and devoured at the edge of the raft after a quick morning dip in the sea. Extra flying fish were used as bait for the great colorful dolphin fish that followed the raft day in and day out across the ocean. Dolphins that we did not eat were used as bait for the great sharks that calmly swam around us day and night. When the sea was high, we could see them sideways as though through a perpendicular glass wall raised high above

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▼ MUSIC AT SEA. Hesselberg, the navigator, entertaining with his guitar in front of the open bamboo hut



the level of the raft. Then the raft tipped up and let the water and the slowly moving sharks pass beneath us. They never seemed treacherous except when we cleaned fish, and they scented blood. Then they would wake up in a fury. Yet we never quite trusted them, and in one day we pulled aboard nine six- to ten-foot sharks just to dispose of their intimate company.

When we slid the sharks up onto our shallow and slippery logs, the remoras, clinging to the sharks' skin by suction, would jump off and attach themselves to the side of the raft; and the pilot fish, having lost their king and master, would find a substitute in "Kon-Tiki," joining us in nice formation before the bow or between the centerboards. If a big blue shark passed, they would occasionally follow him away, but more than 40 of them tailed us right across the ocean until our raft was shattered on the reef.

Although we carried our rations lashed to the logs beneath the bamboo deck, it was still of great importance to me to find out whether primitive man, accustomed to hardship as he was, would have been able to renew his supply of food and water on such a long-lasting drift. The answer was affirmative.

After the fourth day at sea, there was not a single day throughout the journey when we were not accompanied by numbers of dolphin fish. They kept to the side of the raft or beneath us and could be fished, speared, or hooked whenever we desired. Edible barnacles and seaweeds grew all over the huge logs and could be picked like garden greens. And they often housed tiny, edible pelagic crabs or very small fishes. A dozen or more flying fish, often accompanied by baby squids, came aboard almost every night, sailing through the air in schools right above the surface if pursued by dolphins or sharks. Twice in mid-ocean on dark nights, a long snakelike fish with huge eyes and carnivorous jaws jumped right into our sleeping bags inside the bamboo hut and caused a great commotion. It was probably the *Gempylus*, which was seen this way by man for the first time, only a couple of skeletons having previously been found on South American shores. Soaked shark meat, delicious bonito, and yellow-fin tuna completed our seafood menu and made it clear enough that early,

hardy raftsmen were not menaced by hunger.

We carried 200 coconuts and samples of the Peruvian sweet potato and gourd, which were important food plants that the aborigines of Peru shared with those of Polynesia. Those not eaten en route were successfully planted upon our arrival on the islands, to prove that they could be carried on a raft without loss of germinating power. These prehistoric food plants could never have drifted across the ocean without the aid and care of human hands, and the aboriginal name for sweet potato was *Kumara*—both in Peru and on the Polynesian islands.

The early raftsmen along the dry South American coast carried their water supply in gourds or pottery containers and in huge canes of bamboo with the joints pierced out. Left in the shade underneath the bamboo deck, where they were constantly washed by the seas, we found that our plain Peruvian spring water was preserved for more than two months before the first samples began to rot. At that time we had already

▼ HOLDING TIGHT IN CHURNING SEAS: Haugland splicing the steering oar, split during a heavy storm



▲ CRASHED ON A REEF in the Tuamotus: the battered "Kon-Tiki" at its destination inside Polynesia after a westward drift of 4300 miles



entered a part of the ocean where drizzles were frequent and rains occasional, and we were able to collect sufficient rain water for our daily needs. We consumed a ton of water on the journey, along with more than ample rations, and the buoyancy of the balsa logs would have permitted us to double our water supply in easily stored bamboo canes under the deck. With the warm climate creating a demand for salt, we could mix up to 40 per cent of sea water with our drinking water without evil effects. Like our early predecessors and many sailors shipwrecked during the war, we found several simple methods of abstracting the thirst-quenching juice from raw fish, a supply that never ran short.

In this way, with the days full of testings and practical experiments, we found ourselves carried across the ocean bit by bit. By the forty-fifth day we had drifted from the seventy-eighth meridian to the one hundred-eighth and were exactly halfway to the first islands. During those days we were more than 2000 miles away from the nearest shore in any direction. When the ocean was smoothly rolling, we could leave our raft in the little float and row away into the blue space between eternal sea and sky. As we watched our grotesque craft growing smaller and smaller in the distance, an oppressive sense of loneliness came over us. It was as though we were suspended in space, like disembodied spirits. When we rowed back to our distant raft, we felt a strange feeling of relief and were happy to crawl on board our precious, weather-beaten logs and find shade from the glaring sun inside the bamboo hut. The now familiar scent of bamboo and thatched roof made us feel that we were back in our earthly home again, inside a jungle dwelling that was far away from the limitless sea.

We enjoyed our evening meals as the glorious sun sank into the sea before our bow, while sky and water became a dream of colors. Small, striped pilot fish would rush to the surface to snap at our crumbs, and they were occasionally fol-

lowed by a lazy shark, like kittens by a bulldog.

As darkness came we would light our petrol lamp, and Erik would fetch his guitar. Then merry song and music from the raft spread with the dim light over the nearest waves of a trackless, endless ocean. We would soon roll up on the bamboo matting inside the hut, leaving the watchman alone with the stars and the steering oar.

We hit two storms when we approached the end of the journey. The first lasted one day and the second five. With sail down and ropes shrieking, "Kon-Tiki" rode the breaking ocean like a duck. A raft in high seas with wet and slippery logs and no railing requires careful stepping. The second storm had just begun when Herman went overboard. When visible again, he was seen struggling behind the stern. He struck for the blade of the steering oar, but a strong wind pushed us ahead, and he missed. We could not turn our raft around to go back a single inch. There was no possibility of even stopping our stubborn craft in its reckless trek to the west. The airy float would blow like a feather ahead of the raft if put to sea in such a wind. We threw out a life belt, once, twice, but it blew right back on board. We became desperate as Herman, our best swimmer, was left farther and farther behind. With a line in one hand Knut leaped into the sea, and slowly the two friends worked their way toward each other. Thirty yards behind the raft they joined hands, and the four of us on board pulled them in.

We had a green parrot as ship's pet. It was a perfect sailor and a joyous companion, until a big sea stole it on the sixtieth day.

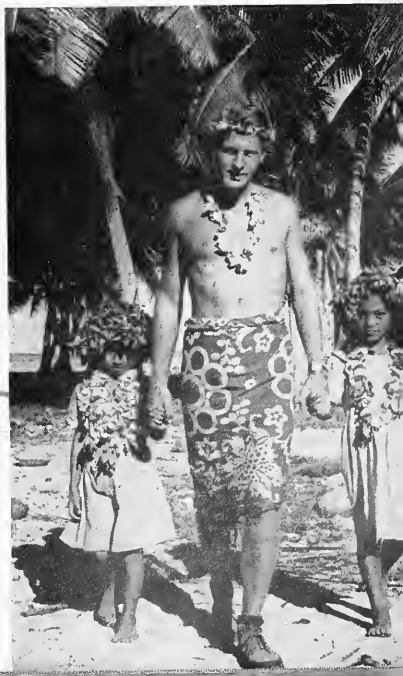
At the end of the third month, we were constantly visited by Poly-

nesian frigate birds and boobies in increasing numbers. Then we sighted a rising cumulo-nimbus cloud, revealing the existence of some hidden, sun-baked isle beneath the western horizon. We steered for the cloud as best we could, and as the golden sun rose from the sea on the ninety-third day, the blue haze of land was outlined against a reddish sky. We were passing the tiny atoll of Puka-puka, but wind and current would not permit us to turn around. We had covered 4000 miles of ocean heading west, and yet we could not force ourselves 4 miles to the east to reach the island. More than ever was this a plain and unmistakable lesson, stressing the fact that in this ocean a drifting craft and a natural migration would inevitably be pushed to the west. And it was with strange feelings that we sat quietly down on our raft and saw the little, solid speck of land—the first and only for twelve weeks—slide away on our port stern. For a moment the wind carried a mild whiff of verdant tropical foliage and smoky native household odors, and we filled our salty lungs before the fata morgana—the mirage of our hopes—sank into the sea.

On the ninety-seventh day an-

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➤ **SAFE IN POLYNESIA:** the author in native *pareu* with young friends from the islands. The author believes the Polynesians are partly descended from prehistoric drift-voyagers from Peru



# MOSES — Pygmies of the Plant World

By BLAIR CHAMBERLIN

AS though endowed by Nature with a compassion for all things old, barren, or unsightly, the gentle mosses draw their soft blanket over the storm-scarred mountainside and soften the bleak outline of rock and dying tree. They lay their healing hands over Nature's wounds and carpet the forest corridors with a tapestry unequaled by any handiwork of man. Moss plants provide nest-building material for some birds and bedding for bears during their long winter sleep. In some northern climates, mosses have been used as padding for babies' cradles, and they are even used in the manufacture of perfume.

Insignificant as the mosses appear, they are essential to many higher plants. They conserve moisture and prevent erosion, reclaim marshlands, and form the birthplace of many streams that start out as mere rivulets seeping from a great bed of moss. The world around, they spread their shaggy mantles over old stone walls, trees, ancient castles, and tumbled-down shanties, on curbstones along busy streets, and even in such unexpected places as an old hat left by some mountain climber high in the Alps.

To examine closely a bed of tiny, glittering moss plants, with either the naked eye or a hand lens, is to experience the thrill of exploring a strange and beautiful world in miniature. Our search will often reveal mosses that look like diminutive evergreen trees, roses, and ferns, while others are shaped like minute stars, ostrich plumes, and myriads of other bizarre shapes and forms. It is little wonder that the folklore of a country such as Ireland with its profuse moss growth is replete with legends of little people, of fairies, elves, and pixies.



Photo by Edwin Way Teale

▲ A CARABID BEETLE in a "jungle" of Hairy Cap Moss

The names bestowed upon many of the mosses speak eloquently of the curious charm they exert on those who have made a study of them. The Wood Revelers, Little Beard Mosses, the Glittering Feather Moss, Golden Cord Moss, Torn Veil, and Fountain Mosses are all names that describe the beauty of these tiny bits of plant life. The Greek botanist Dioscorides and the Roman naturalist Gaius Plinius gave many of the mosses the names they still bear. Pliny was so intrigued by one species of the genus *Polytrichum* that he called it Golden Maidenhair because the tiny veil atop its spore case resembles a maiden's tresses. This species was at first dedicated to Venus and later to the Virgin Mary and was claimed

to have the power of strengthening the hair of anyone who used it in a wash. Another genus, *Catherinaea*, was named for the onetime Empress of Russia, Catherine II.

The name "moss" is often mistakenly applied to many other plants, such as lichens, liverworts, algae, and even some of the higher plants. "Iceland Moss," for example, is really a lichen. "Florida Moss," or "Spanish Moss," is a true flowering plant and not a moss; and the liverworts might be said to be merely poor cousins of the true mosses. The club mosses are not mosses at all. Though they are spore-bearing plants with tiny scale-like green leaves that often spread vinelike on the ground, they vary considerably from the true moss

plants in structure and life history.

The true mosses and the liverworts make up the plant family known as the Bryophyta and are classified midway in the order of plants between the lowest group, the Thallophyta, which includes the bacteria, fungi, algae, and molds, and the spore-bearing plants, the Pteridophyta, such as the ferns, horsetails, and club mosses, which have well-developed stems and roots.

The curious and mysterious mosses are believed to have been among the first forms of plant life on earth. Their ancestors have never been definitely determined, nor is it known whether any other groups of plants have originated from the mosses. It was thought at one time that the liverworts, one of the most primitive groups of plants, were ancestral to the mosses, but recent evidence makes this theory doubtful.

Through the centuries, poets, artists, and philosophers have proclaimed the verdant charm of the mosses and sought to describe their beauty in poetry, picture, and prose. Browning mentions the "elf-needed moss," and Ruskin, who seemed to have an especial affection for mosses, said, "To them, slow-fingered, constant-hearted, is intrusted the weaving of the dark, eternal

tapestries of the hills." To create an atmosphere of peaceful decay and lonely charm, Shakespeare speaks of "an oak, whose boughs are mossed with age."

The known species of mosses are legion. For example, the Little Beard Mosses number 394 species. But there is only one species of Luminous Moss (genus *Schistotega*). Many are surprised to learn that the largest mosses found in southern United States (genus *Fontinalis*) may reach four feet or more in length. The inability of mosses to attain any great size is due to their lack of vascular tissue, which in the higher plants provides the system of pipes or tubes for transporting water and plant food.

Their close relatives the liverworts are even more primitive in structure. They are merely fleshy leaves or ribbons, though some species do have stems from which scalelike leaves project. They are found in damp, shady places and cling closely to the decaying log, bark, or leaves to which they are attached by a multitude of short hairlike roots, or rhizoids as they are called.

In some liverworts, the manner in which the spores are ejected after developing from a fertilized egg cell is another example of Nature's mechanical ingenuity. Tiny

coiled springs called "elaters" are scattered among the spores inside the spore case. These springs remain tightly twisted until the time is ripe for the spores to be scattered. Then they suddenly uncoil in such a manner as to eject the spores from the case in which they have been imprisoned.

The moss plant is a most complex structure and differs in many respects from the higher plants. In the way it reproduces from spores instead of seeds, its life history somewhat resembles that of the ferns. The capsules, or spore cases, containing the almost invisible spores are marvelous examples of Nature's craftsmanship. Brown or chestnut in color when ripe and globular or oval in shape, they rise above the main body of the moss plant on a fragile, slender stem. This whole structure, stem and capsule, is known as the sporogonium and is often tinier than a common pin. You will find it interesting to examine one of these under a magnifying glass. Topping the spore case is a ragged bit of husklike material called the veil or calyptra. Beneath this is a curious lid or cap, sometimes shaped like a tiny dunce's cap, a Tam o' Shanter, or an inverted saucer. When the spore case is properly ripe, this lid comes loose and pops open to reveal a row of minute teeth encircling the top or opening of the spore case. These curious teeth are always four, sixteen, thirty-two, or sixty-four in number. They are so arranged that when they are in the closed position, a single spore cannot escape, but when the humidity is right for the sowing of the spores, these teeth automatically separate and allow the spores to stream out and be blown about by the wind until they come to rest at some distance from the parent plant.

If these spherical spores chance to land in a suitable place, they germinate and grow into a weblike mass of light green threads or ribbons called protonema. Soon this primitive mass of moss tissue sprouts tiny "roots" and branches at several points, and these in time become adult moss plants.

The protonema, having fulfilled



Photo by Blair Chamberlin

▲ WITH MYRIADS OF TINY PLUMES and banners, the moss legions transform a decaying tree into a thing of beauty



Photo by Blair Chamberlin

▲ THIS SHAGGY BIT of Broom Moss shows how the spore-filled capsules rise above the main body of the parent plant

its sole purpose in life, usually dries up and disappears, leaving a group of individual moss plants. These, unlike the preceding generation, later develop male and female parts in tiny dots at the ends of the branches or stems. The male parts produce spermatozoa which are motile. That is, they can move about under their own power. Thus the moss plant can be said in this respect to be part animal—a throw-back to its ancestors whose spermatozoa had the ability to swim about in the warm water of the ancient seas in order to fertilize the female egg cells. When a moss spermatozoon alights on a drop of water caught on the tip of the flask-shaped female organ, it immediately swims to the waiting egg cell and fertilizes it.

The moss plant now reveals another of its peculiarities. The fertilized egg cell, unlike that of a flowering plant, does not develop into a hard seed but grows into a stem and spore-filled capsule—the sporogonium already referred to. Still more amazing is the fact that this sporogonium is not a branch of the moss plant but draws its nourishment parasite-like from the parent plant and is in reality the child of that plant. Thus the life history of a moss plant is divided into two

stages which follow each other in regular alternation.

The Luminous Moss is one of the most fascinating species so far discovered. Found growing only in damp, gloomy caves and old cellars, this weirdly beautiful moss appears to glow with an iridescent light, like a bed of live, emerald-green coals. Under a microscope you can see that the source of this eerie light is in the tiny lenses that these plants have developed in order to concentrate the scattered, feeble, light of their subterranean abode on their chlorophyll cells and thus make possible the photosynthesis necessary for them to exist. Nature has also provided the chlorophyll cells and the tiny lenses with the amazing ability to move about within the leaf in order to keep the changing light concentrated most efficiently. The leaves are only one cell in thickness and stand erect with their flat surfaces turned toward the light. Anyone who has studied mosses wonders how a person can walk past them daily without pausing to see what wonderful things they are.

Mosses have been known to build up deposits of limestone by becoming incrustated with the lime formed by the decomposition of bicarbonate of lime dissolved in streams

flowing through rocky regions. They sometimes become so incrustated that only the green tips of the plants project. Thus the borders of the stream become calcified and raised to a higher level, sometimes in walls almost 50 feet high—an amazing construction job for such elfin plants and one that takes more than 2000 years to accomplish!

Peat Moss or Sphagnum Moss is one of the more common mosses yet one with a most uncommon and interesting background. Usually found in compact green and purple mats along the banks of streams and on the surfaces of bogs and small lakes, its spongelike ability to absorb and retain moisture has made it one of the most valuable water-loving plants. Peat mosses have reclaimed vast areas of wasteland throughout the northern parts of the world, turning them into peat (a useful fuel) and forming some of the most fertile soil to be found. The supply of peat in the United States alone is estimated to contain 12,000,000 tons of dry fuel, and the ancient peat bogs of Ireland have yielded fuel for centuries. Peat bogs have also been found in India and in numerous sections of northern Europe. The Po Valley in northern Italy derives its fame as one of the most fertile spots on the globe because of its vast peat bogs. In the British Isles, as the population increased and the need for more tillable land became acute, the peat bogs were drained and transformed into useful farmland. Today it is estimated that one-fifth of the fertile land in England and Ireland has been reclaimed in this way.

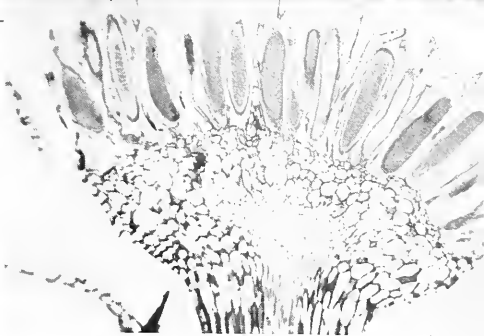
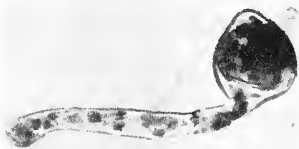
Peat bogs are formed from the remains of countless thousands of generations of moss plants. Taking root around the borders of a small body of water, they gradually grow outward until they form a raft of living and dead plants. As the older parts of the plants die and drop from this living raft, they sink to the bottom and thus gradually pile up an accumulation high enough to meet the thick beds of plants on the surface. Quite often the plants along the borders of the pond grow so profusely that they literally push the floating plants outward until



Photos by K. A. Wagner

▲ THE CAPSULE, or spore case, is often found covered by a husklike veil, or elyptera, quite hairy in the Hairy Cap mosses. Beneath is a lid (right) which pops open to reveal a circle of closed teeth. When the humidity is right, these separate and allow the spores to stream forth. (*Polytrichum piliferum*, magnified 14 times)

▼ THE GERMINATING SPORE sends out a long tube. This becomes a web-like mass of threads or ribbons which sprouts at several points to produce plants having egg cells and male cells. (*Funaria hygrometrica*, magnified 1000 times)



▲ THE MALE CELLS are produced in cylindrical sacs on the tops of male plants, magnified here in cross section 42 times

► THE EGG CELL of a female moss plant (*Mnium*) is seen here in a well-developed archegonium (center), magnified 135 times. The plant that results from the union of the egg and male cell appears as an outgrowth of this plant but is distinct and asexual



the entire surface of the pond is covered with what appears to be a lush meadow. Both men and animals are sometimes deceived by what appears to be a stretch of solid ground but in reality is a "quaking bog." When they break through the treacherous surface, they die a lingering death in the clammy embrace of the semiliquid peat below. Owing to some preservative quality in the peat, the bodies of its victims have often been preserved for hundreds of years.

Another odd thing about peat bogs is their peculiar ability to maintain a uniform temperature throughout all seasons of the year. This property has led to the practice of employing peat beds in Ireland as natural refrigerators for butter and other perishables. Peat diggers still occasionally stumble upon a store of "marsh butter" that has been underground for years and is so well preserved that it is still edible.

The peat bogs of Ireland were once believed to be the abode of supernatural beings. Tales were told of men who entered their gloomy depths and mysteriously disappeared. Many laid these strange disappearances to the will-o'-the-wisps, those weird blue-green lights that are seen dancing about the



▲ FIVE ASEQUAL PLANTS, only two of which have developed spore cases. The spores from these will drift forth to produce the weblike protonema, and the cycle will again be repeated. This is one of the smaller Hairy Cap Mosses, enlarged about two times

bogs on dark nights. Eventually it was understood that the unwary folk had simply perished in the "quaking bogs," and the will-o'-the-wisps were discovered to be nothing more than balls of phosphorescent



▲ THE LIVERWORTS are more primitive than the mosses and are sometimes confused with them. The one shown here, *Marchantia polymorpha* (enlarged 3½ times) produces organs like these for reproduction in the female plant

gas given off by the decaying vegetable matter under certain humid conditions.

In recent years, peat mosses have become of economic importance to nurseries and florists as packing for

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◀ AN EXPLOSIVE SURGE of water quite suddenly gouged this canyon through the forest

As though it were a warning of things to come, the streams near the park headquarters at Longmire began to rise, and for twenty-four hours the ground shook as boulders rolled and thundered down the Nisqually River. At Paradise Valley, in the headwaters of the Nisqually, the rain came down in sheets, with 5.89 inches falling in a few brief hours. Almost unnoticed, the next drainage to the west of the Nisqually—the Kautz Creek Valley—changed from a clear, foaming mountain stream to a sullen, silt-darkened torrent that flung itself against the highway bridge on the park entrance road. Park rangers, patrolling this road, anxiously watched the raging waters as night fell, wondering if the bridge would be there when morning came.

Then, just before midnight, the electric power at Longmire suddenly failed; something had happened to the line. It wasn't until early the following morning that the astonished patrol rangers saw the reason for the power failure. Across the entrance highway was flowing a broad river of mud and water, carrying with it trees and

SOME people travel great distances to see outstanding events, and others have these events brought right to their door. It is seldom, however, that a person is given the opportunity of watching such a breathtaking demonstration of power and destruction as that shown recently when the forces of Nature combined to bring about complete devastation to the beautiful Kautz Creek Valley in Mount Rainier National Park. To the residents of the park, virtually marooned from the outside world for several days, it was a never-to-be-forgotten sight.

It happened in 1947 during the month of October, a season when any kind of weather is likely to hit the region. For several days it had been wet; rains fell that seemed to have neither beginning nor end.

## *The Flood that swallowed a GLACIER*

When floodwaters released their might in a brief, dramatic episode, they swallowed at least a mile of the once majestic Kautz Glacier and swept destruction into a peaceful valley

By RUSSELL K. GRATER

Mount Rainier National Park,  
Longmire, Washington

All photographs courtesy National Park Service



debris of every description. Local residents of Longmire soon collected along the highway to watch the sight.

As you approached the flood area, you could feel the ground quivering as though in torture. A dull roar, growing to deafening proportions as the edge of the flood was reached, gave some indication of the tremendous power that Nature had unleashed. The sight up and down the broad, heretofore heavily wooded and peaceful valley was indescribable. Where once grew a veritable jungle of brush, ferns, and giant trees there now was devastation on a vast scale. Broad areas had been denuded. Small islands of trees were battling valiantly for their lives against a relentless flood that threatened to destroy them at any moment. Here and there, large trees, hundreds of years old and measuring up to five feet in diameter, were ground and hammered by tons of sand and huge boulders until they could resist no longer. Throughout their entire length they would begin to shake and weave crazily; then they would fall with a roar that was almost lost in the noise of the flood. Those that were able to withstand the onslaught were literally chewed and ground almost in half by the liquid sandpaper flowing past them.

The material being moved along by the flood was certainly not water; it was more the consistency of good cement. Paul Bunyan's "cement mixer" the locals called it! Several feet in depth, it flowed sluggishly along, bringing with it large boulders, some of which measured approximately thirteen feet in diameter! Small wonder that few things were able to withstand its full force!

In the midst of all this uproar, alarmed yells brought panic to the people standing on the highway watching the spectacle. The cries were from a party that had skirted along the edge of the flood area and gone a short distance up the valley. Hurrying back toward the highway they warned of an approaching crest to the flood, and the sound of snapping trees and a marked increase in the shaking of



▲ ONCE A HIGHWAY: the entrance road as it appeared after the floodwaters had subsided. Hundreds of huge boulders and piles of large trees choked the roadway for about half a mile



▲ LARGE BOULDERS were piled along the edge of the newly-cut canyon as though a giant plow had thrown up a furrow



▲ WHERE the famous Wonderland Trail crossed there is now a deep gorge



▲ ONCE A DENSE FOREST, now a scene of devastation with huge boulders everywhere

the ground added emphasis to their words. Immediately there was a wild dash to get cars, parked at an apparently safe distance from the flood, to safer ground. To the accompaniment of shouts from adults and wails of fright from children, the cars were finally moved to safety, although one or two over-anxious drivers created near hysteria by flooding their carburetors in their haste to get going.

This last big "surge" turned out to be the final effort of the flood, and the rapidly receding waters soon made it possible to go into the devastated area to see what had really happened. Because of the treacherous nature of the unconsolidated flood materials (some of it so soft that it acted like quicksand) all initial investigations had to be conducted from safer ground in the adjoining forests and on the high ridges.

The area affected by the flood stretched from the Kautz Glacier, high on the slopes of Mount Rainier, for approximately six and one-half miles down the Kautz Valley to its junction with the Nisqually River. First investigations centered about

the glacier in the upper reaches of the valley. From a vantage point almost 1000 feet above the glacier, the story of the flood and its probable cause was readily apparent. In the vast amphitheater once occupied by the glacier, there was now only a deep gorge, approximately 300 feet in depth and 1000 feet wide at the widest point. The glacier itself had been destroyed for a distance of at least one mile and swept away by the floodwaters. Here and there, remnants of the old ice field still perched precariously on the steep walls of the newly-cut canyon of the Kautz. Deep-sided canyons, entering the main gorge, told of powerful streams of water that had poured down the mountainside onto the glacier. To complete the picture of destruction, low-hanging clouds drifted into and out of the black-walled amphitheater, now showing the scope of the new canyon, now hiding it from view. All of this was punctuated with an almost continuous rumbling and roaring as the freshly-cut walls crumbled and fell into the stream far below. It gave an eerie feeling to look into this vast gorge,

once so peaceful but now so terribly torn and changed. Only a few short hours before, this same scene was one of glacial majesty, with the Kautz ice field holding everything in its power. Now it had been overcome by forces even more powerful.

Through a break in the clouds we observed a re-enactment on a small scale of what is believed to have happened the night of the flood. From the steep slopes of the new canyon came a slide of loose rock and debris that piled up in the stream course, temporarily damming its flow. For a few moments there was quiet as the waters deepened behind the barrier. Then the entire mass began to move down the stream, sweeping everything ahead of it. A sullen roar, growing louder as the rocks poured down the steep stream bed, echoed and re-echoed through the amphitheater. Very likely this demonstrated the mechanics of the great "surges" that caused the destruction of the lower reaches of the glacier and swept through the broad valley of the Kautz.

A short distance below the great



where, Kautz Creek, once again a small stream, flows in the foreground

amphitheater the canyon narrows abruptly and passes between high cliffs on either side. Below this "box" a gorge approximately 60 feet in depth was cut as the flood surges swept through. Here an entirely new stream channel was cut, with the old bed of Kautz Creek left high on the side of the canyon. As the water came through the "box," its power was so terrific that it literally blew out a new course through the forest, tearing out trees by the hundreds and thrusting them like so many jackstraws out through the timber.

For the next two miles below the "box," the gorge slowly becomes shallower, with its depth varying from 60 to 10 feet and its width about 125 feet. It was along this stretch that the surges developed their full power of destruction. In places the flood burst out through the forest and cut great swaths through the trees, only to pour back into the main channel farther downstream. In places mud was found on trees higher than a person could reach. Huge boulders were piled high along the canyon rim, like a furrow from a gigantic plow.

Here and there large blocks of ice from the destroyed glacier could be seen among the rubble. Over all hung the odor of mud and new earth, with occasionally the still stronger smell of resin from the crushed evergreens.

Below this newly-cut canyon the flood spread out fanlike through the forest on a front a half-mile wide until it hit the Nisqually River. In this region, the courses of the surges changed quickly as new channels were cut, only to be choked by rocks and logs that forced the floating, swirling material in another direction. It was this process, repeated over and over again, that caused such destruction to the forest cover.

Through the field studies made, it was possible to reconstruct the probable events of the flood. Clearly the Kautz Creek drainage

had been running at its maximum when rains in cloudburst proportions hit the great amphitheater wherein lay the Kautz Glacier. As the water poured through the tributary canyons onto the glacier, they cut a deep gorge into and through the ice near its terminus, exposing loose rock debris beneath. Immediately this material was whipped out by the swirling flood, and water began to impound in the depression thus formed. Now the ice of the glacier began to collapse, allowing the great head of water to move downward toward the narrow walls of the box canyon in a great surge of rock and debris. As this mass moved, it plowed out a gorge many feet in depth. As it reached the box canyon, the ice and boulders were jammed in between the narrow walls, creating a temporary dam that partially held back the



▲ LOOKING into the Kautz "box" with the Kautz amphitheater beyond. The old creek bed may be seen high on the canyon rim to the left

floodwaters crowding in behind. Higher and higher rose the water, exerting greater and greater pressure on the dam, which finally burst, creating a virtual "explosion" that blew out a gorge through the forests below the box canyon.

Sweeping down the Kautz Valley, this great force pushed everything in front of it in its swirling march toward the distant Nisqually River. The entrance highway offered only a minor obstacle in its path and was quickly erased. In the meantime, new surges developed in the narrow box canyon below the rapidly crumbling Kautz Glacier, and these swept down through the newly-cut canyon, deepening and widening it. As the last of the glacier lying within the great amphitheater was destroyed there developed the final and destructive surge that was witnessed by the local residents of Longmire.

The immensity of this flood can best be realized in the amount of rock and rubble it moved during its course. Engineers figured that *at least 50,000,000 cubic yards* of solid material were excavated by the raging waters and were either spread out through the forests in the lower Kautz Valley or poured into the Nisqually River. There the flood forced the river out of its channel, causing thousands of dollars worth of damage to houses and property farther downstream. Some conception of this huge figure can be obtained by comparing this "excavation" job with the one accomplished by man in the building of Hoover Dam. The excavation at the dam totaled approximately 8,000,000 cubic yards, or *one-sixth* that moved by Kautz Creek! It took the best engineers and equipment *three years* to complete their excavation miracle. It took Kautz Creek less than *fifteen hours* to excavate and move six times that amount!

While the residents of Longmire may forget their isolation from the outside world, which lasted for several days, they aren't likely to forget the drama and devastation witnessed that rainy October morning when the Kautz Valley was destroyed.

# WEED CONTROL WITH 2, 4-D

Whether you want to get rid of poison ivy or weeds in your lawn, this new chemical is the answer; but take these precautions when you use it

ANYONE reading advertisements and circulars concerning the use of 2,4-D (2,4-Dichlorophenoxyacetic Acid) may leap to the conclusion that practically all of his weed problems have at last been solved. Some people concerned with the manufacture and distribution of 2,4-D, as well as many who have tested it, envisage weed-free lawns and grain fields, ragweed-free roadsides and vacant lots. Undoubtedly 2,4-D is one of the most important discoveries of recent years and one that can bring enormous benefits to man, provided it is properly used. But if not properly used it may cause irreparable damage.

In small amounts 2,4-D acts as a stimulant to the growth of plants. In stronger concentration it kills them by overstimulation. This is the property that makes it valuable as a weed killer. It is a hormone that is particularly destructive to broad-leaved plants, because they absorb it more readily than narrow-leaved ones. Thus it permits a selective action. But it must be remembered that there is probably not a single plant, wanted or unwanted, that 2,4-D will not kill.

During the past two years I have been conducting extensive experiments with 2,4-D at the Bear Mountain and Harriman State Parks, about 50 miles north of New York City. While weed problems at Bear Mountain have been, for the most

By C. H. CURRAN

*Curator, Department of Insects and Spiders,  
American Museum of Natural History*

part, of a special nature, it has been possible to observe the effect of the chemical on a great variety of plants and to study its effects on associated animal life. Our tests show that many kinds of desirable plants are easily killed and that the weed killer consequently cannot be used in close proximity to these plants, even though it may seem impossible for the spray to reach them.

When I was a boy I was taught that dandelions were most undesirable things to have in lawns. I developed a strong dislike for them because each year I was given the task of removing them from our lawn. It was not an easy job. Some of them could be cut off by use of a hoe, with the blade filed to a sharp cutting edge, but others near the cement walk had to be removed by means of a sharpened putty knife. If one cutting a year had done the job, it might not have been so bad; but I soon learned that from one to five new heads came from many of the cut plants, and precious hours of my vacation had to be given over to getting rid of them.

Our ideal at that time was a lawn where grass grew luxuriantly and provided a beautiful green carpet upon which we could gaze with pleasure and upon which my

brothers and sisters could romp and roll. On warm days chairs were scattered about, and sometimes the adults would invite us to join them in a glass of lemonade. I could admire this beauty despite the fact that it was my duty to keep the grass cut (a mere matter of two hours a week) and even though the hated dandelion kept cropping up, with leaves that grew much faster than the grass and spoiled the smooth, green carpet. Also, there was white clover, lots of it, interspersed among the grass, and I remember how this stayed green when we had long dry spells in summer. There were no plantains on the lawn itself, but many grew on the driveway, which was nothing more than two wide, hard-packed tracks which wagons and, later, cars had ground on one side of the lawn. These plantains were another of my worries, but they were rather easily controlled. Once their heads were cut off, they were finished; but they were prolific things, and each year the new crop had to be cut.

When I went to college, I discovered that our professor of botany had had experiences similar to mine

and as a result had spent considerable time experimenting with chemicals to kill unwanted weeds. He had plots marked out containing nothing but grass—no dandelions, no plantain, no clover. But for some reason, the plots didn't look right. The grass was coarse and heavy. It did not have the velvety appearance of the fine grasses and clover found in untreated areas. I also discovered that his treatments were relatively expensive.

When 2,4-D came along, it became immediately evident that it might offer definite relief for people concerned with the care of lawns; and it was only natural that the manufacturers of the chemical stressed the elimination of weeds in lawns and golf courses as their first selling point. Many of them mentioned dock, ragweed, and poison ivy as pests easily destroyed, but the latter was not included by those who were cautious in their claims. Actually, when 2,4-D was first publicized, very little was known about it. Even today its use must be considered experimental; it will be many years before we can use the chemical with definite

assurance that it will do what we want it to without causing possible damage. There are already several very definite uses for 2,4-D; but whenever you use the chemical you should note carefully its effects on the plants to be destroyed, on other plants, and on the soil in general.

The eight acres of playing field that extend from Bear Mountain Inn south to beyond the Administration Building of the Palisades Interstate Park Commission has considerable variation in soil conditions. In the spring, when soil water is abundant, there is a copious covering of grass and clover with a healthy scattering of dandelions. Although the grass is cut frequently, the older dandelions grow rapidly, and the even beauty of the lawn is soon destroyed by the prominent flower stems and semierect leaves. This is a situation that requires attention, and in the past it was customary to put a crew of men to work cutting out the weeds and hauling them away.

When I was asked if there were a more effective method, I immediately suggested 2,4-D. A casual examination of the situation indicated that a general spraying would not be advisable, since this would kill off the clover and leave

*Photo courtesy E. I. du Pont de Nemours and Co., Inc.*

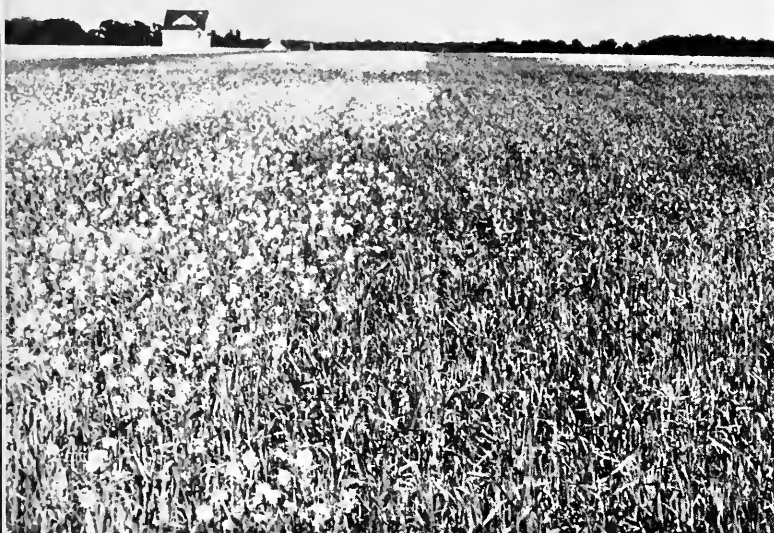


▲ ITS SELECTIVE ACTION is what makes 2,4-D useful in weed control. At left, an area of lawn treated with 2,4-D; at right, an untreated area with weeds growing unchecked. But watch the strength of the solution, and do not let spray drift onto desirable plants

▼ CANADA THISTLE, a bane to farmers in some regions, wilts promptly when treated with 2,4-D. Poison ivy and hay fever plants can also be controlled by it. But a dose that may not harm a blade of grass may kill a tree







*Photo courtesy E. I. du Pont de Nemours and Co., Inc.*

▲ IN PROPER DILUTION, 2,4-D kills broad-leaved vegetation like the mustard shown here, without harming the narrow-leaved cereals and grasses. It even acts as a growth stimulant in weak solutions; so the user should know exactly what he is doing

large, bare patches of soil. Spot spraying was the only thing. A crew of men moved over the lawn and sprayed every dandelion they saw, and even though some clover was also affected, very little was killed. A slow killer, 2,4-D took from one to two weeks before completely withering the treated plants.

There were many areas of the field that had been churned up by cars, trucks, and athletic activities, or where the soil had been hard-packed, as on portions of the baseball diamond. On these areas humus was largely lacking from the topsoil, so plantain had established a firm hold. (Plantain always indicates poor soil, not well suited to the growth of grass and clover. Under such conditions, it is often possible to aid these plants and discourage plantain by loosening the soil to a depth of two or three inches and keeping it loose.)

While the number of plantain plants was small in proportion to the dandelions, they were actually much more unattractive since there was little grass to conceal them. With spot spraying it was possible to eliminate most of the plantain in about three weeks, but this left

conspicuous, bare areas, often several feet in extent.

It was not until after completion of the spraying that I realized I had paid little attention to the quality of soil on various parts of the field. It was obvious, of course, that the soil was very poor where the plantain grew. Investigation showed that a good part of the field had been filled in with rock and subsoil and that in places the topsoil was quite shallow. Moreover, the field had been neglected during the war years. As a result of the rock fill, water seeped away quickly, and in dry weather the grass soon turned brown, whereas clover, dandelions, and plantains remained green.

Plantains have small, shallow roots, so their removal is not apt to open the soil to permit seepage of rain water. But dandelions have rather large, deep roots. When the roots die they decompose, leaving a considerable amount of humus. They also open the soil, allowing air to circulate and moisture to seep in instead of running off after a rain. In view of this, it becomes obvious that in the case of many lawns it is not advisable to destroy

all dandelion plants. The presence of a few should be welcomed. The old (large) ones may be destroyed to advantage. Now that we have 2,4-D, we can easily destroy them by spot spraying. But they should not be removed without foresight, except from lawns that have a deep topsoil or can be kept properly moist by watering.

The claim has been made that white clover is not killed by 2,4-D. It has been stated that the leaves die but that the plants recover quickly. This may be true if the spray is just strong enough to kill dandelions and plantains in a single application. But I have found that some clover will even be killed by a single application and that two or three applications will wipe it out almost completely. Since clover roots may penetrate deeply into the soil and since they build up the nitrogen content of the soil, it may be harmful to eliminate them.

It has been freely admitted that bent grass, a desirable type, is killed by the normally used concentrations of 2,4-D. Since much of the grass seed planted in American lawns is a mixture including bent grass, it is obvious that the use of 2,4-D without knowledge of the kinds of grasses growing in a lawn may result in serious damage.

Until we know more about 2,4-D and its possible effects on lawns, it seems advisable to apply it only by spot treatment to unwanted weeds, and to be careful not to allow the spray to blow onto flowers and other broad-leaved plants. At recommended concentrations, it will not kill most narrow-leaved plants. However, it is wise to watch the concentration carefully, or it may kill grass. At the concentration recommended on the container, the salts are soluble, but they are liable to settle out. The sprayer must be very frequently agitated, and there must be no concentration of the salts on the bottom. If this occurs, many patches devoid of vegetable life may result.

#### **Golf Greens**

Keepers of golf greens find 2,4-D a godsend. The golf course is not comparable to a lawn. In both we



would like to have no clover, no dandelions, no weeds of any kind but only an even carpet of healthy grass. But golf greens are well watered, and the grass is kept green at all times. Because of the large areas on a golf course, power equipment may be used to advantage. With such equipment it is possible to move along rapidly. Thus the greens may be kept free of undesirable plants by one or two treatments a year. Since power sprayers are normally provided with agitators to keep the chemical in solution, there is little danger of killing grass. The only possible danger comes when too many applications are made in one season. One should not expect a golf-green lawn without using golf-green treatment.

#### Hay Fever Control

In the minds of many people, ragweed and hay fever are synonymous. At the time that ragweed is in bloom, from June until September, countless people suffer from hay fever, and most of those who undergo allergy tests react to ragweed pollen. Others react to the pollen of roses, goldenrod, various grasses, mustard, and a wide variety of other plants. Some people

are affected by the scales and hairs of insects, others by dust and by aromas used in perfumes. However, there is little doubt that most hay fever sufferers can blame ragweed, and the elimination of ragweed would bring them relief.

Ragweed is one of the many plants easily killed by 2,4-D. It usually grows on very poor soil, along roadsides and in vacant lots. In many respects, it likes the same places that plantain does, but it fares better with some shade. Caretakers of roads and parkways do not like ragweed because it often becomes unsightly.

In 1946, the City of New York undertook a ragweed extermination campaign, hoping to bring relief to its hay fever sufferers. The campaign was well organized and well carried out. All the known patches of ragweed were sprayed with 2,4-D. I followed the results with interest; apparently about 90 per cent of the Giant Ragweed (*Ambrosia trifida*) and from 75 to 80 per cent of the Common Ragweed (*Ambrosia artemesifolia*) were destroyed. The height of the Giant Ragweed at the time it blooms varies from two to fifteen feet, and the plant is quite easily

recognized. However, its pollen is not believed to be very important as a cause of hay fever.

The Common Ragweed is a very different looking plant. It thrives best on poorer soil, seldom grows to a height of three feet, and may flower profusely when less than a foot high. Flowering plants from four to six inches in height occur in abundance along roadsides. It is the chief cause of hay fever, but because of its smaller size and the greater difficulty in locating it, it is more difficult to exterminate than the Giant Ragweed.

This program will certainly bring some relief to hay fever sufferers where the cause is ragweed. Many of those in charge of the maintenance of roadways are looking forward to the day when the shoulders of roads will receive chemical treatment for the elimination of unwanted plants. When that day comes, the vast majority of ragweed in the country will be killed off. The time is not far away, but there is still the problem of applying the spray in such a way that it will not kill roses, other plants, and trees, which form an essential part of the landscape.

The hope is small that hay fever



Photos courtesy the Dow Chemical Company

BEFORE AND AFTER: at left, an untreated dandelion; at right, the same plant 48 hours after application. "Spot treatment" is recommended where surrounding growth may be injured



victims of goldenrod may receive relief through the use of 2,4-D; and those who suffer from rose pollen can have scarcely any hope, because no lover of roses is going to stop growing them. There are scores of different kinds of goldenrods. Some grow along roadways, others in fields, in woods, in swamps, and along the seashore. The cost of eliminating them would be prohibitive. Also, many people value the cheery golden flowers of the goldenrod as an integral part of the countryside—even some of those who suffer from the effects of the pollen.

#### *Poison Ivy*

When 2,4-D first appeared on the market, there was some doubt about its effectiveness against poison ivy. The leaf of this plant is so smooth that any spray applied is likely to run off quickly. However, there is now no doubt that 2,4-D is the answer to the poison ivy problem. If the proper spray is correctly applied, it will definitely kill the plant, but the user must bear in mind that different brands of 2,4-D give different results. Also, it is generally advisable to soak the plants thoroughly with a solution containing from one-third to one-half more 2,4-D than is recommended for other weeds.

At Bear Mountain early results were quite varied, because I was using various strengths of 2,4-D and various kinds of "wetting agents." These are materials that allow the spray to spread rapidly in a very thin film over the leaves. It then dries quickly and there is less danger of the spray being washed off by rain before it produces the desired effect on the plant. I found it possible to kill young poison ivy plants growing in abundant sunlight by using a spray containing only one ounce of one hundred per cent 2,4-D powder to five gallons of water; but this did not kill them in the shade. Further tests revealed that it was possible to kill poison ivy plants of any age even in the shade by using two ounces of 2,4-D to five gallons of water, plus any of several kinds of wetting agents.

Practically all 2,4-D now on the market contains a wetting agent. One spraying was effective within two days to two weeks. A second spray may be necessary to eliminate plants that were overlooked.

To anyone planning to spray poison ivy I would suggest that unless a greater strength is recommended for poison ivy on the container, twice as much 2,4-D be used as is recommended for plantains or dandelions. Adjacent plants and grass may be killed. The woody plants of poison ivy are hard to kill, and frequently the plant lives entirely in the shade. Poison sumac, which occurs in swamps, is easily killed by 2,4-D.

#### *Use with Cereal Crops*

This chemical is proving of great value in the control of weeds in fields of cereal crops. Where these crops are grown extensively, it is possible to spray from airplanes for the control of mustard, vetch, thistles, and other broad-leaved plants. Tests have shown that the increase in yield much more than pays for the expense of spraying, and the quality of the grain is higher. This is to be expected, since weeds in grain fields use food and water essential to the growing of the cereals themselves.

The chemical has been recommended for use in cornfields, but its value here has apparently not been fully demonstrated. I have found that young corn plants, and young leaves on older ones, are affected by 2,4-D and may be killed or deformed. In growing corn it is general practice to "hill" it once or twice. This is done by hoeing the soil from between the rows and heaping it about the corn plants. This practice takes care of the weeds. It seems highly probable, however, that the use of 2,4-D for killing weeds late in the season and perhaps eliminating weeds in the "hilled" rows would have a very valuable effect the following year. And the hormone effect of the chemical might increase yield during the same year that 2,4-D is applied. This problem is receiving much attention at the present time, and it is confidently expected that

the yield of corn will be considerably increased when a proper program has been worked out.

#### *Some Dangers*

The use of 2,4-D is so new that we do not know all of its advantages and disadvantages. While we may be certain that it will prove of great value, we should not use it without considerable possible bad effects. We know that it will kill a great variety of unwanted plants or weeds, but it will also kill many kinds of desirable plants.

At Bear Mountain I found that the Flowering Dogwood, one of the most beautiful plants of the hillside and one frequently grown about homes, is very susceptible to 2,4-D spray. Some plants growing more than 50 feet from the point at which the spray was applied had most of the leaves killed as a result of drifting spray. Other plants, closer to the point of operations, had all the leaves killed. This happened despite the fact that the spray was being applied to ground plants and low shrubs. The leaves of all kinds of birch trees turn brown within a day after spraying, and young trees are quickly killed. Birch trees more than 200 yards from the point of spraying turned brown within 24 hours after the spray had reached them. Beech trees are almost as susceptible as birch, and no spraying should be done near them. It is not believed that large trees will be killed as a result of a single "browning" treatment, but it is possible that treatment during several successive years might cause their death.

Many flower and garden plants are also very susceptible to 2,4-D, so great care should be used when applying it to lawns near flower or vegetable gardens. It should be applied only when there is no wind or when the wind is blowing away from the garden. Then the spray nozzle should be held close to the unwanted plant.

#### *Various 2,4-D's*

Different brands of 2,4-D are being marketed under many different trade names. As presently manufactured, 2,4-D salts and esters,

which form the basis of the commercially sold 2,4-D products, are not standardized. The salts obtained from one manufacturer may not produce the same results as those made by another company. There is no question about the value of any of these products as weed killers, but there is always the danger that when one switches from one brand to another, different results may be obtained. If you have been using brand A, you may find that your results are just what you want. You switch to brand B and find that the same methods and dilutions are not killing the plants as quickly, if at all. Then brand C may not only kill the weeds but also your grass.

These differences are to be expected in a new product. In fact, some of the 2,4-D products are specifically intended to act differently. It is well known that different "spreaders" or "wetters" change the effects of 2,4-D. Some of these are developed especially to kill grasses or woody plants. Some 2,4-D esters are being developed to destroy "hard-to-kill" plants and grasses. Therefore, each one must be used according to directions on the package. And if desirable plants are damaged, you must remember that climatic conditions may alter the normal action of 2,4-D and that plants normally immune can be killed during some delicate stage of their development.

Since 2,4-D kills plants by making them grow enormously—by making their roots, stems, and leaves develop all out of proportion to normal growth—narrow-leaved plants are generally safe because, in the amount applied, they are not overstimulated. From observations at Bear Mountain, it seems apparent that when 2,4-D is used for controlling weeds, plants not killed by it are apt to be stimulated. This stimulation certainly carries over at least one year.

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## Do You Know Your Birds?

By GEORGE W. LYON

A jay walker may not be a bird, but he may remind you of a bird not supposed to have much sense. Below are hints to enable you to name some fifteen birds. Using these hints, get as many birds as you can. Ten or twelve correct will be a good average.

1. A disrespectful imitator.....
2. It might turn out cloth.....
3. It might be a feathered financier.....
4. You might think it were a bit intemperate.....
5. The most feline of birds.....
6. It carries a musical instrument.....
7. It might sow a few wild oats.....
8. A bird that could help in the office.....
9. It might not be *sane*, as birds go.....
10. It should feel at home in a church.....
11. A musical instrument plus statement of account.....
12. The color of its plumage suggests a high churchman.....
13. This bird could have graced the Garden of Eden.....
14. A color compounded with a nail-driving tool.....
15. Its name suggests material used for making tents.....

Correct answers on page 238

## MOSESSES—PYGMIES OF THE PLANT WORLD

Continued from page 275

plants in storage and shipment because of their ability to soak up and hold water. Peat moss mixed with regular soil is also widely used in the growing of plants. The ability of the Sphagnum Mosses to hold water is readily understood when a fragment of the plant is examined under the microscope. Its main body is seen to consist of large colorless cells with circular openings in their walls so arranged that water from one cell can flow into another. In tiny spaces between these water compartments are very minute particles of chlorophyll, or leaf green, and other substances that make up the living plant. When Sphagnum Moss is dry, it is gray or almost white in color; but when it gets wet it displays a brilliant green because the water in the large cells makes them more transparent and permits one to see the color of the small cells through them.

To anyone who enjoys the world

of nature, mosses offer a most fascinating field of study. Collecting mosses is a hobby that almost anyone anywhere can enjoy. Moss plants are found practically everywhere and at any season if you know where and how to look for them. A hand lens or a low-power microscope can be the key to this fascinating world in miniature. A clump of moss no larger than the palm of your hand will often display several hundred individual plants, so if you are seeking a hobby and are cramped for space, it would be hard to find one that requires less. On field trips a multitude of specimens can be collected in noth-

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ing larger than a lunch box. When dried and stored in glassine or cellophane envelopes, they can be kept indefinitely for study. Each specimen should carry a few notes on the habitat, place, and time it was found. To dry samples of moss, place them between sheets of blotting paper and put them under moderate pressure. When these dried specimens are wanted for study, merely soak them in clean hot water for a few minutes, and they will be restored to their original freshness.

Many interesting facts can be observed with the naked eye alone, but to explore fully the minute details of the spore cases and the cross sections of the leaves and other parts will require a hand lens. It should be mounted so as to leave the hands free to dissect the parts under study. A needle and small tweezers are all that are needed for dissection. To obtain cross sections of stems and branches, I have found the best method is to cut through a number of plants with a sharp knife or razor blade. Among the pieces thus severed will be found some that show the structure.

This Tom Thumb hobby can provide many hours of enjoyment for anyone who appreciates the wonder and beauty to be found in nature. You will discover that, aside from their artistic charm, the mosses make use of many ingenious mechanical devices and chemical processes which enable them to carry on their ceaseless struggle for existence and to reproduce their species. To anyone with a philosophical turn of mind (and who among nature lovers isn't something of a philosopher?) they offer rich rewards in the contemplation of exquisite handiwork. Here in this intriguing midget plant we can see the ever-inspiring evidence of Nature's artistry, her mechanical precision, and her mystical, often unexplainable life processes.

*Further Reading*

Those who are interested in learning more about the mosses are referred to H. S. Conard's *How to Know the Mosses*, published by H. E. Jacques, Mount Pleasant, Iowa.—Ed.

**THE VOYAGE OF THE RAFT  
KON-TIKI**

*Continued from page 271*

other island grew up out of the ocean, straight ahead of us in line with the bow. As we approached, we saw from the top of the mast that a roaring reef was twisted like a submerged snake all around the island, blocking the approach to the palm-clad beaches behind. All day long we struggled in the current alongside the island to keep clear of the boiling reef and yet be close enough to attempt a land-fall wherever an opening might be seen.

Late in the afternoon we sighted the first natives on a beach, and we hoisted all our flags in joy. A great commotion was seen on the beach, and shortly after, the first Polynesians in small outrigger canoes slid through a passage in the reef and swarmed aboard the "Kon-Tiki." A strong wind blew up, and our ocean raft struggled away from land as the sun went down in the sea. There was a desperate fight against the elements, in which we were assisted by all the friendly natives who were able to get out and join us in the open sea. As the dark night engulfed the island and the sea, a great campfire was lit on shore to show us the direction of the entrance through the reef. But the wind increased its grip and won another battle. When the glare of the great fire dwindled like a spark in the distance and the roar of the reef was no longer heard, our excited native friends jumped into their canoes to return to their homes on Angatau for fear of drifting with some crazy strangers into the open sea. And we drifted farther into the heart of the Tuamotu, or Dangerous Archipelago.

One night an unusual motion of the raft awakened me, and I suspected land ahead. Next morning, our one hundred-first at sea, we were alarmed by the watchman on the top of the mast, who had sighted an enormous reef that spanned the entire horizon ahead of us. It was the treacherous 20-mile reef of Raroia Atoll. With white spray shooting high into the air, the surf battered the endless reef in fury.

NATURAL HISTORY, JUNE, 1948

As we rode directly into this boiling inferno, we had three hours to prepare for all eventualities. We lowered the sail and threw out an improvised anchor on a long rope that kept sliding along the bottom. We carried valuable cargo into the hut and lashed it fast in watertight bags. We cut off all ropes holding the centerboards in position and pulled them up to get a shallow draft. With shoes on for the first time in 100 days, we concentrated on the last order: Hang on—hang onto the raft whatever happens!

The first walls of thundering water broke down upon us from above as soon as our logs ran against the solid coral reef. Tons of crashing water tore up the deck, flattened the hut, broke the hardwood mast like a match, and splintered the steering oar and stern

crossbeam, while we were thrown in and dragged out, thrown in and dragged out, by the furious ocean. During these minutes, when we cramped every existing muscle to withhold the deadly grasp of the passing seas, we made up for all the leisure of the average ocean day. I felt the last of my strength giving away when a wave larger than the others lifted "Kon-Tiki" free of the water and tossed us high up on the reef. Other waves pushed us closer to shore, until we could jump off the raft and wade the shallow coral reef to a tiny, uninhabited coconut island. Never did any tiny piece of land embody paradise so perfectly to me as this verdant, palm-clad isle with its white and shiny beach facing a crystal-clear lagoon, calm as green glass.

A week later we were found by natives who had detected from another island six miles across the lagoon the drift wreckage and the light from our campfire. And about the same time "Kon-Tiki" was carried by high seas right across the solid reef and left becalmed inside the lagoon. The nine main logs that had carried us 4300 miles across the ocean in 101 days were still intact, and after an unforgettable two-week Polynesian welcome party on lonely Raroia, our battered raft was towed to Tahiti by the French Government schooner "Tamara," which was sent expressly to pick us up.

We shall never forget the welcome on these Polynesian islands.

From Tahiti the "Kon-Tiki" was carried as deck cargo back to the Norwegian Museum of Navigation in Oslo.

## LETTERS

*Continued from page 244*

Mr. Bogert mentioned many times the undesirability of venomous snakes. Yet he hardly mentioned the vast amount of good that harmless snakes do for agriculture. He told of the damage that bull snakes did to waterfowl eggs in one refuge, but he left unmentioned the fact that the bull snake is one of our most valuable native animals to agriculture in the Midwest and that it is one of the greatest single factors in keeping noxious rodents under control. The average person, after reading this article, wouldn't know a bull snake from a copperhead.

It seemed to me that Mr. Bogert should have dwelt more on the value of harmless snakes and less on methods of mass eradication. If people only knew the true facts concerning snakes, they would not have to worry about "ridding the premises" of them, because they would no longer be governed by an unreasonable fear of them. Fear of snakes is out of all proportion to the facts. Surely Mr. Bogert, as Curator of the Department of Reptiles and Amphibians, must be interested in greater popular knowledge of the value of reptiles.

Wildlife has certainly suffered enough at the hands of ignorant crusades, such as might easily be promoted by an article like this. Too many uninformed people

kill every snake they see without stopping to find out whether it is poisonous or not. It is definitely not the place of NATURAL HISTORY to publish an article which advocates the general destruction of snakes.

STERLING BUNNELL.

San Francisco, Calif.

• • •

The article referred to was published in response to numerous requests for information about how to identify and control venomous snakes. Even so, the

article defended harmless and beneficial snakes as follows: "Snakes, like other animals, have a place in nature. Many of the smaller kinds habitually feed upon earthworms, slugs, crayfish, insects, or spiders, but such predations play an insignificant role in the control of animals that might be regarded as pests. Some of the larger kinds, including copperheads, rattlers, and especially the bull snakes of the middle western prairies, are of importance in rodent control . . . Indiscriminate killing is inadvisable . . .



POND LILIES: A natural design in circles, photographed by Fritz W. Neugass

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Large-scale campaigns of eradication should never be attempted without the advice of a competent naturalist . . . The danger from venomous snakes is exceedingly small . . . Rattlesnakes, copperheads, moccasins, or coral snakes are . . . to be respected . . . as potential destroyers of destructive disease-bearing rodents," etc., etc.

In past issues of NATURAL HISTORY we have devoted much more space to the value of snakes than to their control. But there are dangerous snakes, and it is our aim to give a balanced view of nature. This was avowedly an article on dangerous snakes; and as such, we feel that it gave reasonable emphasis to the importance of protecting useful ones.—Ed.

• • •

Sirs:

I expect that the article in the April number, "The Problem of Snake Control," will bring you a torrent of mail. May I add my little bit of personal experience?

My advice to people who dislike snakes is to have cats. Two years ago, when we built a cabin on our little farm in southeastern Louisiana, the place was overrun with snakes, especially in the spring. That first year two long colubers came right into the house. I like snakes; I did not mind. Last year, during the whole year I saw only two snakes. One, a big king snake, lived under the chicken coop, 50 yards from the house. I respected him greatly and never disturbed him. The chickens, many of them biddies, paid no attention to him at all. The other—and here is where my point comes in—was an 18-inch highland moccasin. He entered through the mesh of the chicken coop and killed one hen; maybe she died of fright. I heard the commotion, but it was still dark, and I waited until daylight to go out. When I did, my two cats came running to me and acted very strangely. They are both tabbies, one a very large yellow male, the other very small and gray. They crossed my path, they "sang" in their throats, they ran back and forth between me and the little bush close to the entrance of the chicken yard. There I found the moccasin more dead than alive. My cats had, mongoose fashion, worried him to death. He could not strike at all; a little whack of my riding whip, and he was dead.

I have long known of the hatred of felines for reptiles. My little ocelot in Colombia had a toy-articulated snake that he used to kill systematically every time he encountered it. Cats serve the double purpose of ridding one of mice

and rats and warning one of the presence of snakes. My cats are excellent rattlers; my feed bins show no sign of rodents this year, and I have not seen one snake close to the house. I personally have to be mighty sure a snake is poisonous before I kill him, poor thing.

Mrs. ANDREE DESBRIERE IRWIN.  
Madisonville, La.

• • •

The following comment is offered by Charles M. Bogert of the American Museum's Department of Amphibians and Reptiles:

Mrs. Irwin's account of the cats killing the highland moccasin (copperhead) is of interest, although cats that kill venomous snakes are certainly the exception. Correspondence over the last two decades has included letters from several persons whose cats have killed garter snakes or, more often, small ring-necked snakes. Also, in the West there are stories of a few dogs that have learned to kill fair-size rattlers. Where rattlesnakes are abundant, dogs are often bitten, and a few succumb. Still, the percentage of cats and dogs that will not retreat from a venomous snake is relatively small.

#### Other Glowworm Caves

Sirs:

I was much interested in your article on the glowworms of the Waitomo Caves, New Zealand. It contains, however, two rather unfortunate errors. The name should read *Arachnocampa luminosa* Skuse, instead of *Arachnocarpa* as printed. It is stated that it is native only to New Zealand and that it exists nowhere else. Glowworms of this type, larvae of small mycetophylid midges, occur not uncommonly in Australia and Tasmania in caves, and in damp situations under rock-ledges. One species occurring in the Tasmanian caves, *Arachnocampa tasmaniensis* Ferguson, belongs to the same genus as the New Zealand form; another allied species with a luminous larva, *Ceroplatus mastersi* Skuse, occurs in various localities in New South Wales. There is little doubt that other species with similar luminous larvae exist here, but little is known of their life histories.

KEITH C. MCKEOWN,  
Entomologist.

The Australian Museum,  
Sydney, Australia.

NATURAL HISTORY apologizes for overlooking Australia's glowworms and for a typographic error in the technical name.  
—Ed.

#### Giant Prehistoric Birds from New Zealand

Dr. Robert Cushman Murphy, Chairman of the Department of Birds, returned recently to the American Museum of Natural History from a five-month expedition to New Zealand, accompanied by Mrs. Murphy, his companion on many expeditions. Readers who recall the many

articles that Dr. and Mrs. Murphy have previously written for NATURAL HISTORY will anticipate with pleasure the accounts they have promised to write on their visit to New Zealand.

Among other objectives, Dr. Murphy has secured the first complete skeletons ever taken from New Zealand of individual Moas, prehistoric Pacific birds. The prized fossil birds, including one almost perfect giant standing ten feet high, were unearthed in co-operation with New Zealand scientists. It is stated that skeletons of such perfection and of such a variety of species have never before been excavated and shipped from New Zealand, the sole home of the prehistoric Moas. Soon after their arrival at the American Museum, the Pacific giants will be placed on public display—the first complete individual skeletons of Moas to be exhibited in America.

The treasure-trove of prehistoric bird life represented by these examples was uncovered in New Zealand's Pyramid Valley Swamp near Waikari, Canterbury Province, South Island. No fewer than six different species of Moas and the remains of other extinct birds, including the bones of the Giant Rail, are in the collection that is now on its way to the Museum. The collection is believed to be one of the most significant contributions to recent paleontological history from that part of the world. Most of the fossils are of birds that inhabited New Zealand from one to tens or hundreds of thousands of years ago. Dr. Murphy states that the Pyramid Valley Swamp is still relatively untouched but that a host of other plant and invertebrate fossils have been uncovered, all in a state of preservation that almost matches conditions in the famous Rancho La Brea tar pits, near Los Angeles.

In the course of this expedition, Dr. and Mrs. Murphy together with Dr. R. A. Falla, Director of the Dominion Museum of Wellington, and other New Zealand colleagues, made a two-week trip to the remote subantarctic Snares Islands, south of New Zealand, to study the habits of oceanic birds and to make the necessary studies for an exhibit in Whitney Memorial Hall.

Studies for a second Museum habitat exhibit in Whitney Hall were made at Lake Brunner, in the mountainous western part of South Island. This exhibit will include a restoration of a small Moa known as *Euryapteryx*, the only member of its family that survived to a date when primitive man could hunt and eat it. Remains of this Moa have been found in the refuse deposits of the Maoris, indicating that it lived in New Zealand at least until the fourteenth century of our era.

Dr. and Mrs. Murphy were guests of the New Zealand Government during their travels, which took them to all parts of the three main islands and to many outlying islets.

#### Answers to quiz on page 285

- |                 |                      |
|-----------------|----------------------|
| 1. mockingbird, | 8. secretary bird    |
| 2. weaverbird   | 9. cuckoo            |
| 3. dollarbird   | 10. parson bird      |
| 4. swallow      | 11. hornbill         |
| 5. catbird      | 12. cardinal         |
| 6. lyrebird     | 13. bird of paradise |
| 7. lark         | 14. yellowhammer     |
|                 | 15. canvasback       |





September **NATURAL HISTORY** 1948

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6 A DAY WITH DUTCH CHILDREN

7 HANS, OF THE SWISS ALPS

8 PEDRO PICKS COFFEE IN BRAZIL

9 YUKIKO AND A JAPANESE CARNIVAL

10 CHILDREN ON ENGLAND'S CANALS

11 KANA, PRINCE OF DARKEST AFRICA

12 PAULI AND HIS HAWAIIAN FEAST

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# LETTERS

## Largest Orb-weaver

SIRS:

Professor Berrill's account of "The Hen-pecked Sex" shows clearly the difficulties that beset the sexual behavior of the male. A spider he may have had in mind when mentioning discrepancies in size is a not uncommon orb-weaver in the Florida Everglades. The first time we met one, the male escaped our notice entirely. The huge web, five feet across, was strung on sturdy silk cables over a back road. In the center of the orb clung the female, silhouetted against the sky. And what a silhouette. From her two-inch body came long legs banded dusky tan and jet black—but from the black bands grew a fuzz of hair that reminded us of cartoons of a goon! One of us climbed onto the roof of our car with a butterfly net at its longest extension and swept the creature from her perch. Afterwards we learned about her mate. He must have been in some obscure corner of the web, subsisting on forgotten flies.

This past spring, we were in the Everglades again and came face to face with another of this same spider, *Nephila*. She was just about at head height and had shed her skin only a few hours before. The old skin was tangled in the web, and the whole structure showed signs of neglect. Even the males, of which there were four, showed no concern over their huge mate. Usually they kept their distance, but occasionally one scampered across the web, up over the body of the female, and down the other side. She paid no heed—just hung there head downward, legs outstretched. We snapped her by photoflash and were happy to have a record of the difference in size between the sexes, as seen in the accompanying picture. Her body is beautifully patterned, and her web is set at intervals with little tufts of white. When disturbed, she shook herself violently in the web, and all but the little tufts blurred almost to the point of disappearing. In fact, she shook it so hard that one of the males fell out and tumbled to the ground, but he soon climbed back on a silken line thrown out as he dropped. The others clung to the strands for dear life.

LORUS J. and MARGERY J. MILNE.

The spider shown in the Milnes' photograph, *Nephila clavipes*, is our largest orb-weaver, and the male has been estimated to be only one-hundredth the weight of the female. In other species the difference in weight is even greater; in some the ratio is said to be one to one thousand. In spite of this small size, the male is not completely immune to



▲ *Nephila clavipes* and her tiny male (upper right)

the attack of the female and must perform a sort of courtship by pulling at the web threads before mating takes places.

This is the spider used by Wilder in this country in his early efforts to obtain spider silk for commercial use, but there is little hope that spider silk can be produced economically enough to compete with the silkworm.—Ed.

## 2,4-D and Hay Fever

SIRS:

Goldenrods (*Solidago* spp.) mentioned on several occasions as important hay fever plants in the interesting article on 2,4-D, in the June issue of *NATURAL HISTORY*. It is easily understood why these plants should so often be misrepresented, for even prominent textbooks on systematic botany erroneously mention them as hay fever plants.

Actually the great majority of the species of these beautiful plants cannot possibly cause hay fever, for their pollen masses are exceedingly viscid and cannot get into the air to be passed to some poor soul to cause hay fever. . . . Only two localized species, *Solidago sempervirens* and *S. speciosa* (the former found only in coastal salt marshes), have been

shown to shed pollen that becomes atmospheric, and even these have yet to be proved important hay fever plants.

Undoubtedly our goldenrods have been given this "black eye" because they are prominent, colorful plants in bloom at hay fever time. Their close associates, the ragweeds, with inconspicuous flowers, are generally the real culprits. Let's not 2,4-D our goldenrods, at least not until proof is found of their guilt!

W. H. HODGE.

Amherst, Mass.

SIRS:

While the purpose of this note is to call your attention to an oversight in one of the articles in the June issue of *NATURAL HISTORY*, it would hardly be fair to do this without expressing high appreciation of the Magazine both in content and format. . . .

Dr. Curran, in his article "Weed Control with 2,4-D," enters into a discussion of hay fever control. His general conclusion in the first paragraph on this subject is correct, that ragweed pollen is the cause of most of the hay fever in this country. But it is misleading to say that "countless people" suffer from ragweed hay fever "from June to September."

It is true that a few ragweed sufferers in Florida begin to experience symptoms as early as June, and certain species of

*Continued on page 292*

# NATURAL HISTORY

The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVIDSON, President

ALBERT E. PARR, Director

VOLUME LVII—No. 7

SEPTEMBER, 1948

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## THE COVER THIS MONTH

The genus *Heliocereus* contains only five species, natives of Mexico and Central America, but there are several scores of named hybrids and horticultural varieties. The plants are easily propagated by cuttings, and when grown out of doors during the summer they tend to make strong branches and may even become erect and bushy. It is difficult to grow them under glass, but if one is successful in this, they will flower abundantly during the winter. All are red or scarlet-flowered except one which has white flowers.

The plants of this group are called "sun-cereus," and the one illustrated on the cover this month is a hybrid of *H. speciosus*, the "king cactus," with a species of *Eptiphyllum*. The king cactus comes originally from central Mexico and perhaps parts of Central America. It grows commonly on the Pedregal near Mexico City, where it forms large masses, usually growing in the potholes and at the mouths of dark caves, sprawling over the rocks and occasionally rooting from the branches. It lives also at high altitudes on the mountain ranges south of Mexico City. Like its immediate relatives, its flowers are diurnal, and this fact has given rise to the names *Heliocereus* and *sun-cereus*. The individual flowers are six to seven inches long and last for several days. Common names in Mexico are "Santa Marta" and *xoalacatl*.  
H. N. MOLDENKE.

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EDITOR: Edward M. Weyer, Jr., Ph.D.

Elizabeth Downes, Editorial Assistant.  
Atherlie E. Karp, Editorial Assistant.

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*Franseria* cause ragweed hay fever symptoms even in March and April in certain parts of Arizona and southern California. Furthermore, large amounts of ragweed pollen are found in the air along the Louisiana and Texas coast throughout October, and a few stray plants may still be in bloom in Florida in November. But the average time of onset of ragweed hay fever symptoms throughout the central and eastern states is August 10-15—even later in the Gulf states.<sup>9</sup>

The statement that "others react to the pollen of roses, goldenrod, various grasses, mustard, and a wide variety of other plants" can probably be proved technically true, but it is equally misleading. It is a mistake to bracket the highly important wind-pollinated grasses with the absolutely unimportant insect-pollinated roses, goldenrod, and mustard. A person may react to a skin test with mustard pollen, but there is only the slightest chance that this would have any clinical significance. Mustard pollen cannot be inhaled under normal circumstances. Plants probably produce hay fever symptoms in other ways than by their pollen. Some persons "cannot be in a room with roses without sneezing," just as some cannot tolerate certain perfumes; but much of this is psychological. There is the well-authenticated case of a lady who sneezed just as violently at the sight of artificial roses as at real live roses. "Rose fever," as commonly referred to, is a popular designation for grass pollen allergy. In 23 years I have tested no less than 40,000 air samples from all parts of the United States and southern Canada, yet I have never found a single granule of air-carried rose pollen and seldom one of goldenrod.

In discussing giant ragweed, the author observes, "However, its pollen is not believed to be very important as a cause of hay fever." This may represent the opinion of some doctors in the New York City area but not those who have published books on the subject. Practically every allergist in the United States treats his ragweed hay fever patients with a combination containing equal parts of short and giant ragweed pollen.

Finally, it is questionable whether any experienced allergist would accept the conclusion that by eliminating all roadside weeds "the vast majority of ragweed

in the country will be killed off." It is true that in some areas and under certain conditions grain fields are plowed before the ragweed season, but in the great Mississippi Valley most of the grain fields produce a crop of ragweed after harvest. I have had opportunity to observe this matter in almost every state. Obviously, the acreage of these fields greatly exceeds that of the roadsides.

O. C. DURHAM,  
Technical Director,  
Pollen Committee of the  
American Academy of Allergy.  
Abbott Laboratories,  
North Chicago, Ill.

### "Wood Bitch"

Sms:

I have read with much interest in your valued Magazine an article entitled "Scorpion" of the Treectrops," in the May, 1948, issue.

I note that this article is about a so-called "five-lined skink," a lizard extant on the Del-Mar-Va Peninsula (more particularly, on the so-called eastern shore of Maryland). Hereabouts, while some people call these creatures "scorpions," others give this lizard a possibly more picturesque if less euphonious name—"Wood Bitch." However, I have never found anybody in this locality who didn't insist that these creatures are poisonous, your article to the contrary notwithstanding.

If these lizards are not poisonous, why is there such a widespread belief up and down the eastern shore of Maryland that they are poisonous? Furthermore, I had the following experience in connection with one of these lizards. As we were erecting a cabin in the woods on the upper part of the southeastern branch of the Bohemia River, I had occasion to kill a smaller and different kind of lizard—darkish, with yellow stripes running crosswise along the length of it. This lizard is frequently known locally as a "Ground Puppy." It is also sometimes considered poisonous. I have even heard it said that on occasion those who wish to do away with dogs have killed and cooked these lizards and fed them to the dogs to poison them! At any rate, we killed this kind of a lizard, much smaller than the so-called "skink" of your article.

Presently, by coincidence, we saw what an old resident there called a "Wood Bitch." This creature resembled the skink described in your article, having horizontal stripes running the length of it and a red nose. Also, when we hit it with a stick, its tail snapped off, as you have also described. . . .

At any rate, we killed both of these lizards and laid them side by side under a tree. The next day the ants had all but carried off the carcass of the smaller lizard, the "Ground Puppy," but had left the "Wood Bitch" entirely alone.

From this it was hard not to draw the conclusion that the "Wood Bitch"

or "Scorpion," as it is frequently called hereabouts, has some kind of poison in it that kept the ants from touching it—again, your article notwithstanding.

I would appreciate hearing more from you on this.

ALFRED N. PHILLIPS, JR.

Cecilton, Md.

The following comments are offered by C. M. Bogert of the American Museum's Department of Amphibians and Reptiles:

Most of the questions in Mr. Phillips's interesting letter are readily answered, but it is not easy to explain why so many erroneous beliefs concerning reptiles are widely held. In virtually all parts of the world where reptiles occur, the most outlandish notions about them are accepted as fact. Primitive peoples are even more gullible in this respect than those in civilized communities where compulsory education has spread information, if not the ability to reason. Nevertheless, an astonishing number of highly educated and otherwise intelligent people are quite willing to believe that snakes suck milk from cows, that hoop snakes can place the tail in the mouth and roll down hills, or that snakes swallow their young to protect them.

Many pseudo-biological ideas can be traced back to Aristotle or Pliny. Repeated by literary scholars, or handed down by word of mouth, these preposterous myths are believed by large segments of the population, despite the existence of published factual information that readily disproves them. Unfortunately, it is difficult to distinguish fact from fancy, and the most "reasonable" assumptions may prove to be groundless. Animals occasionally do things that seem quite as unbelievable as those attributed to them in myth and fable.

In the case of animals alleged to be dangerous, the possibility that they *might* be is sufficient to discourage investigation by the uninitiated. Hence the belief spreads, even though someone may have looked into the matter a century ago. In the case of the "wood bitch," it might have been known that similar lizards lack grooved teeth or venom glands, and it is easily demonstrated that neither is present in the skink. The bite of the "wood bitch" produces only the symptoms of a similar wound from ordinary causes—if the lizard does manage to break the skin. Simple experiment does not always settle the matter, however. A controversy waged for two or three decades before it was definitely proved that the Gila monster had grooved teeth and was venomous. No one living in Arizona, where this lizard is found, now questions this. But in the same region one often hears the erroneous notion expressed that "blue-bellied lizards are poisonous." When doubt is hazardous, many individuals prefer caution to evidence, and nothing short of the spectacular will convince them. Moreover, people tend to

Continued on page 335

<sup>9</sup>For maps showing the seasonal and geographic distribution of fifteen hay fever plants in the United States, the reader is referred to *NATURAL HISTORY* for March, 1939.

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# YOUR NEW BOOKS

ROAD TO SURVIVAL • OCEANIC BIRDS • PLANTS  
MOUNT EVEREST • SHELLS • FISHES • GEMS

## ROAD TO SURVIVAL

----- by William Vogt

William Sloane Assoc., \$4.00  
335 pp.

IT is a rare book that can be called epoch-making. This one may or may not be, but the reader is likely to conclude that it will be, or else—

There is not a word of "sensationalism" in Mr. Vogt's vocabulary, but, of all the well-documented studies relating to the exhaustion of natural resources, his is the most urgent and dramatic. It is unlikely that any amount of logic or dialectic can gloss over the picture he paints.

The lower animals subsist on the produce of their immediate environment. When food gives out, they move or starve. Few of them have storehouses outside the tissues of their own bodies. Furthermore, disease and enemies take an ordained toll, and net increase is restricted to the carrying capacity of an untitled range.

Man, particularly gregarious man of the past few millennia, is a case apart. He transports food to himself in greater quantities than the range can continue to supply. Industrialization has upped his numbers immoderately, and now medical science has made a huge cut in his death rate and doubled his expectation of life. The decade extending over the last war was a period of horribly abnormal mortality. Yet the *net increase* in the human population of Europe was eleven millions! In India it now approximates 14,000 per day.

Man, being an extraordinarily large creature (there are only 200 bigger, and the average bulk for all animals is about that of a house fly), is an enormous consumer. He has filled up or used up the pioneer lands, such as those that yielded a temporary lease of survival to a depleted Old World after the discovery of America.

There are no more adequate and extensive areas still unutilized. Two-thirds of the people of the world are hungry and undernourished, yet breeding goes on merrily, approved by the *mores* of many discreet traditions.

The "Book of the Month Club" is to be congratulated in its choice of this superlative document. Don't miss it if you want to see how the most important problems facing mankind can be handled dispassionately but without gloves.

R. C. MURPHY.

## FOUNDATIONS IN THE DUST

A Story of Mesopotamian  
Exploration

----- by Seton Lloyd

Geoffrey Cumberlege, Oxford  
University Press, London,  
New York, Toronto  
237 pp.

WE are all so familiar, through museums, books, and illustrated papers, with the treasures of Ur, the stone sculptures of Assyria, and the seals of Babylonia that we may find it difficult to realize how completely the great civilizations of the Euphrates and Tigris plain had sunk into oblivion and how little was known about them as late as the middle of the nineteenth century. Unlike Egypt, with its pyramids, temples, and colossal stone statues, these lands presented nothing to tell of the glories of the past, save vast and amorphous mounds of crumbling bricks and dust. What little knowledge existed was derived from the late writings of Greek historians and from the Old Testament and gave hardly an indication of the age and scope of the Mesopotamian civilization. Babylonians and Assyrians seemed to have been little more than tyrannical conquerors, who from time to time invaded Palestine and abducted into exile parts of its population, eventually to be punished for this by having to crawl on all fours and eat grass, like Nebuchadnezzar, or by having their cities cursed, like Nineveh by the prophet Jonas.

The author, one of the leading archaeologists in the field and Technical Adviser to the Directorate of Antiquities of Iraq, tells us the exciting story of the recovery of those grand old civilizations from the modest beginnings when, 150 years ago, British political agents in Baghdad first began to take an interest in the ancient

ruins. There followed the marvelous feat of the decipherment of cuneiform script, first as early as 1802 in Germany by Grotefend, whose work was so little esteemed by scholars that it was not published, and later independently by Rawlinson.

Then came the first excavations, carried out in Assyria by the French Consul Botta and by Sir Henry Layard, the penetration into an ever remoter past, and the discovery of the works, the language, and literature of the Sumerians, a people whose very existence had been forgotten for thousands of years. All through the second half of the nineteenth century, the excavations, as far as their methods were concerned, proceeded by trial and error and all too often degenerated into a mere hunt for museum specimens. The period of really scientific methods began only around 1900, when German scholars started to excavate Babylon and Ashur. It culminated in Sir Leonard Woolley's sensational discoveries at Ur, in the various expeditions of the Oriental Institute of Chicago, the University Museum of Philadelphia, the British Museum, the German Orient Society, and, in recent years, the excavations carried out by native Iraqi scholars. The book ends with a brief report on the excavations at Hassunah, in 1943, which seem to carry us back to the very beginnings of higher civilization in the early part of the fifth, if not in the sixth, millennium B.C.

ROBERT HEINE-GELDERN.

## THE STORY OF PLANTS

----- by John Asch

C. P. Putnam's Sons, \$5.00  
407 pp., 185 figs.

HERE is a book that combines the history of botany, plant physiology, structural botany, paleobotany, systematic

## ISLAND LIFE in Lake Michigan

by ROBERT T. HATT<sup>2</sup> and collaborators

*The habits and distribution of the vertebrates,  
correlated with geological and cultural history*

171 pages \$4.00 postpaid

CRANBROOK INSTITUTE OF SCIENCE • Bloomfield Hills, Michigan

botany, organic chemistry, the effect of nuclear physics—in short, a summary of the important features of plant life, described in language that a person with little or no knowledge of botany and related subjects can understand without consulting a glossary or dictionary. The author, John Asch, is the son of Mr. and Mrs. Sholem Asch. He was born in Warsaw, Poland, but he became an American citizen and was educated in American schools. He was graduated from the National Farm School at Doyleston, Pennsylvania. He was a student and voluntary worker at the Citrus Experiment Station at the University of California. For a time he worked at plant exploration work with the Hebrew University at Jerusalem. He has visited every experiment station and botanical garden throughout the United States, Europe, and the Mediterranean area.

In short, this is a thoroughgoing accurate, and dependable piece of work, more copiously illustrated than any book of the kind known to this reviewer, and the drawings, which were done by Tabea Hofmann, are excellent in quality and very helpful in the comprehension of the story.

To be a bit more analytic, a few of the subjects treated are cytological development, Mendel's Law, fungous parasites, bacteriology, edible and poisonous mushrooms, how plants scatter their seeds, horticultural experiments, agriculture, the foundation of civilization, how forests affect civilization. This is not a textbook, but it contains all the essential features of a textbook, put in an attractive and fascinating shape. It is amazing to note how much work has gone into one book, and it has not been padded.

CLYDE FISHER.

## OCEANIC BIRDS OF SOUTH AMERICA

- - by Robert Cushman Murphy

The Macmillan Co., \$17.50  
1245 pp., 16 color plates,  
221 photos and figs.

THE recent publication of this two-volume classic brings to the public a book that was called "one of the most absorbing and exciting publications in the field of natural history" when it was originally issued a dozen years ago in an edition of only 1200 copies. Because the book stood as a monolith in its field, the edition was promptly exhausted. The meager supply was thus scattered over almost the whole known world, from the White House and the library of at least one monarch to the head of the Tribal Council of the Navajo Nation and the Siberian Section of the Russian Geographical Society in Irkutsk. Soon, one wishing to acquire the set had to pay a collector's price.

Because the book has been thoroughly

reviewed from the scientific point of view, no such appraisal is needed here. Unlike many books of great scientific worth, *Oceanic Birds of South America* is conspicuous for its pleasing flavor as well as for its intellectual calories. Beyond being an encyclopedia of bird lore, it describes the aims and adventures of the scientists whose explorations have yielded such a fund of knowledge. Not least interesting of these are those of the author himself, whose many thousands of miles before the mast and via shanks' mare have carried him to a position of world renown as an ornithologist and geographer.

The sixteen full-color paintings adorning the book were all done especially for it by the celebrated bird artist, Francis Lee Jacques.

So, if you do not know how a penguin flies underwater or that a guanay eats almost nothing but anchovies, feast yourself on this intellectual banquet and share in the enjoyment of a monument that took the author more than two decades to perfect.

E. M. W.

## A FIELD GUIDE TO THE SHELLS OF OUR ATLANTIC AND GULF COAST

- - - - - by Percy A. Morris

Houghton, Mifflin Co., \$3.50  
190 pp., 42 illusts.

THIS small handbook for the Eastern and Gulf Coast fills a real need for the amateur shell enthusiast. One of the greatest difficulties in writing a book of this type is the selection of the species to be included. I believe that Mr. Morris's choice has been fortunate and that the approximately 400 species discussed include most of the shells that are likely to attract the attention of the amateur collector. The descriptions are concise and graphic without repeating the old hackneyed phrases, which seem so commonly to pass on from one compilation to another. While the common names are given wherever such names appear to be well established, the author is to be congratulated for resisting the temptation to fill in the blanks with manufactured names. In the discussion of many species, Mr. Morris has included a brief account of their habits and natural history.

No formal synonymy is given, but a sufficient number of the older names are mentioned in the text to clear up most of the confusion that might result from an attempt to use this guide in conjunction with some of the older books.

The omission of the author's name from the scientific names is, I believe, an unnecessary simplification, which may detract slightly from the value of the book. It seems particularly odd since the

meaning and use of the author's name is explained in the introduction. The book is fully illustrated and includes a number of attractive color plates. There is an adequate glossary of technical terms.

JOHN C. ARMSTRONG.

## AUSTRALIAN BIRD LIFE

- - - - - by Charles Barrett

Oxford University Press, \$3.25  
239 pp.

AUSTRALIA is world-famous for its many aberrant types of birds. There are bower-birds and birds of paradise, emus and lyre birds, as well as a host of colorful parrots and pigeons. Could, the Audubon of Australia, made this avifauna known to the rest of the world in a series of folio volumes that are now among the most precious of all ornithological publications.

Among the many books on Australian birds that have appeared recently, this is one that is within the reach of everybody. In a series of seventeen chapters, the principal types of Australian birds are discussed in a rather conversational manner, and some interesting facts are reported on the more noteworthy species.

The most valuable feature of this book is a series of excellent photographs of the various types of Australian birds and also of their nests and displays. A number of colored plates depict some of the more brilliant species. The information, on the whole, is correct, but there are only sixteen species of rails in Australia and not sixty as stated.

ERNST MAYR.

## A HISTORY OF FISHES

- - - - - by J. R. Norman

A. A. Wyn, Inc., \$6.50  
463 pp., 157 illusts.

IN the 21 chapters of *A History of Fishes* by the late J. R. Norman, there is a veritable storehouse of facts about these denizens of the water and their manner of life. An excellent index facilitates its use as a reference. More often than not, the facts about any matter relating to fishes, which might take one hours to come by in some library, can be found clearly presented here in a few minutes.

Furthermore, this is one of the most scholarly, comprehensive books on the subject published in the English language in our time. One thing it will not do is identify the thousands of species of living fishes, but the excellent drawings by Colonel Tenison portray a considerable number of the more interesting ones. Here also are many true and fascinating fish stories, interestingly told; one will remember the habit of the remoras of getting free transportation by attaching

to sharks and other large marine creatures, and that of the archerfish, which knocks insects from overhanging vegetation or out of the air with accurately directed jets of water. The author also describes how the tiny parasitic male among the deep-sea anglers grasps its much larger mate and becomes merely an appendage to her, and he tells about the migration of fresh-water eels to spawn in the deep sea and the return of their young.

As there is a great demand for this very useful volume (first published in 1931 and out of print for some years), this new edition is most welcome. It differs from the original only in the addition of a foreword by Col. Tenison, and of an account and figure of *Latimeria*, the most remarkable fish discovered alive in recent times, five feet in length, weighing 127 pounds, and of a type thought to have been extinct for 50 million years or so.

J. T. N.

## POPULAR GEMOLOGY

----- by Richard M. Pearl

John Wiley & Sons, \$4.00  
316 pp., 112 figs.

FOR accurate information about gem stones, coupled with readability, we can recommend this new book by Richard Pearl of the Department of Geology of Colorado College. Mr. Pearl has a mineralogical background which gives him an acquaintance with minerals and their occurrence and spares him the pitfalls into which the popular writer is likely to fall. On the other hand, his book is not so technical that mineralogical training is necessary for an understanding of half of what is said.

The various jewelry stones are taken up in succession and are arranged in the mineralogical sequence to be used in the new Dana System of Mineralogy. The rare stones are described in considerably more detail than in many textbooks. The commoner stones, on the other hand, are rather briefly treated, giving an impression that many of the rare stones are more important than they actually are, commercially speaking. However, since most of the people who buy gem books are likely to be those interested in the less common stones, this is hardly a fault. Mrs. Jones, whose sole piece of jewelry is a diamond ring, is not the usual buyer of a gem book!

The illustrations are interesting and show many mineral specimens in good crystals. Some are a little foreign to the book, but, on the other hand, they add to the interest of the mineral collector who is only casually interested in the specialization of others—precious stones. Though there are only a dozen common and significant jewelry minerals, the truly interesting ones are the little-known

stones. A dip into this group is stimulating and gives one an appreciation of minerals not obtained in other ways. Most of the visitors to the Morgan Hall, it must be confessed, are led there by a desire to see the gems; only after being led astray to the minerals do they realize how beautiful many of them are. Mr. Pearl's book would be a good introduction.

F. H. Pouch.

## MOUNT EVEREST 1938

----- by H. W. Tilman

Cambridge University Press, 15s.  
160 pp., 49 illstrs.

THIS is the official account written by the leader of the last Everest expedition, the seventh if we include two made for reconnaissance. It is a thin volume; yet it gives a complete story of the expedition, commencing with the preparations and selection of climbers. A map shows the route from India and another the north side of Everest, with the usual approach to the North Col from the east and the alternate climb from the west, used for the first time by this expedition.

Appendices include a discussion on Everest expeditions, by the Royal Geographical Society; one on use of oxygen,

by Lloyd; scientific observations, by Odell, showing two geological sections through Mount Everest; and comments by Tilman on the "Abominable Snowman," as Tibetans call the mythical (?) creature whose tracks have been observed in the snow of the Himalayas. Noteworthy among the photos, mostly taken by Smythe, are the Compa of Shekar Dzong and the tremendous views from Camps V and VI.

The story carries one along with the party, and, as in Tilman's other books, there are bits of dry humor as when on the first weary march the climbers "wonder if man was really intended to walk, whether motoring after all is not his natural mode of progression."

Tilman makes a good case for the small expedition costing £2500 compared with previous large ones costing four times as much. His argument is sustained by the achievement of his party of seven. With the help of 31 Sherpa porters, they established the usual camps with Camp VI at 27,200 ft. and made two tries for the 29,141 ft. summit, both hopeless because of deep powder snow brought by an early monsoon.

Anyone interested in the Mount Everest problem or one who enjoys a tale of high endeavor should read this "chapter" in the unfinished story of the mountain.

RICHARD L. BURDSALL.



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ON first glance, you might have considered the Huaca Prieta a poor place to dig. It looked like a natural hill a little over 400 feet long and 165 feet wide, rising 60 feet above the beach. The remains of two adobe brick pyramids about a mile to the north of it are higher and much more impressive. But examine the Huaca more carefully. It is not a natural hill but a pile of refuse—an ancient camp ground or village site that rose simply through the accumulation of ashes, cast-off food scraps, and other rubbish. The adobe pyramids could have been built in a few generations. The Huaca Prieta had obviously taken centuries. You can imagine my excitement when I realized how far back in the history of the Western Hemisphere this site went and that it had exactly what I hoped it would have on the basis of a careful analysis of local conditions along this coast line before setting out on this expedition.

The circumstances that brought us to this out-of-the-way spot in the Chicama Valley in northern Peru were simple enough. When the Spaniards first gained control over the old Inca Empire, Europeans began to speculate about the history and origin of the Peruvians. Shortly after the conquest, the King of Spain ordered that the legends dealing with their past be recorded. These provide a reasonably accurate picture of the Inca Empire back to about A. D. 1200. Earlier than that, the legends are of little help, and we must literally dig our information out of the ground.

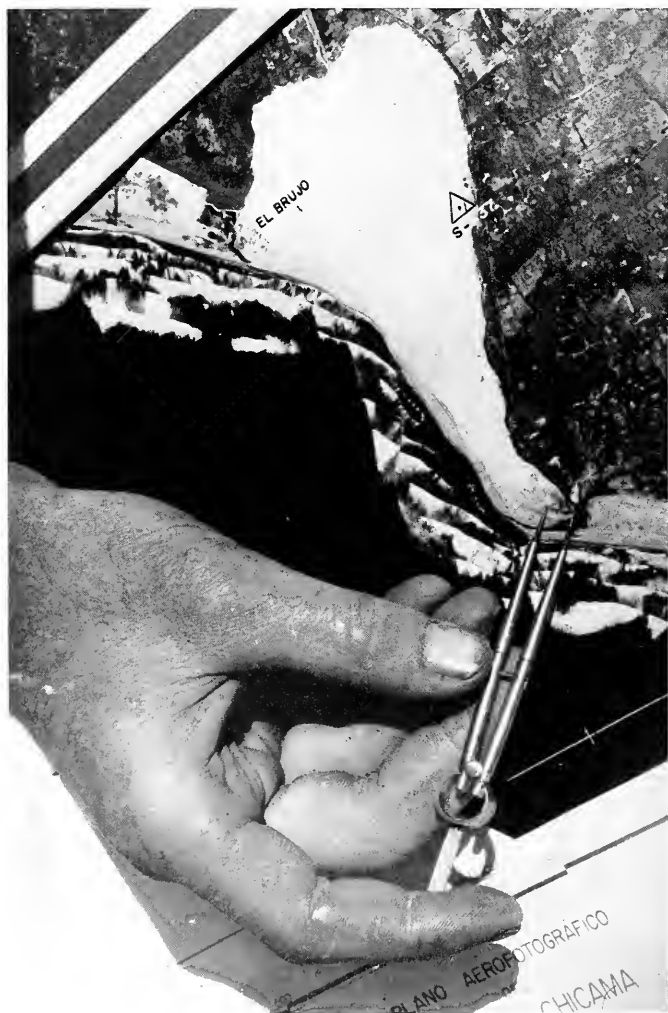
Through the years a great mass of material, such as pottery and textiles, has been recovered, but all too frequently there has been little information as to exactly where it came from and what other material was associated with it. The relatively little systematic collecting that has been done has yielded rich dividends in knowledge and has shown a long sequence of cultural development, varying considerably from one part of the country to another.

The magnitude of the task, the wealth of easily procured material,



# AMERICA'S ○

An American Museum expedition to Peru uncovers an unknown chapter in the early history of America—a glimpse of the epic of human life from perhaps 3000 B.C.



▲ AIR PHOTO of a section of the Peruvian coast, with the dividers spanning the Huaca Prieta mound. Here digging was begun in an effort to discover the earlier periods of Peruvian prehistory. The light area is a low desert plateau rising above the adjacent farm land and bordered by surf on the west

# OLDEST FARMERS

By JUNIUS BIRD

Associate Curator of Archaeology,  
American Museum of Natural History

All photos by John Collier, Jr.  
except where otherwise credited.



and the lack of funds have discouraged a co-ordinated or planned approach to the study of Peruvian prehistory. The result has been that both Peruvian and foreign archaeologists have worked as they were able, following whatever leads seemed most promising.

As an experiment in a more concerted program it was proposed that a thorough study be made of a single coastal valley. The Peruvian coast, as you know, is a desert area, where farming is limited to the valleys receiving water from the mountains. The population in

the past, as well as at present, has been concentrated in these valleys, so the remains of their ancient cities and towns, irrigation systems, pyramids, and forts are clearly grouped in valley units. The proposed plan called for a study of the present population and how they utilize the land, a survey of as many archaeological sites as possible, and an effort to clarify and extend the known cultural record of the former inhabitants.

The valley finally chosen, the Viru, located about eight degrees south of the equator, was selected for various reasons. Dr. Wendell C. Bennett, one of the organizers of the program, had already worked there for the American Museum; it was comparatively small and was well located in relation to important centers of great pre-Inca cultural achievements, and a complete aerial photograph coverage was available.

The plan, as developed, called for the joint participation of several



Photo by Junius Bird

➤ A HEAP of ashes and debris marks the site of a farming-fishing community abandoned before maize was known in Peru. South end of mound

➤ A GREAT PYRAMID of clay bricks erected centuries later near the mound. Jeep is at left base of structure



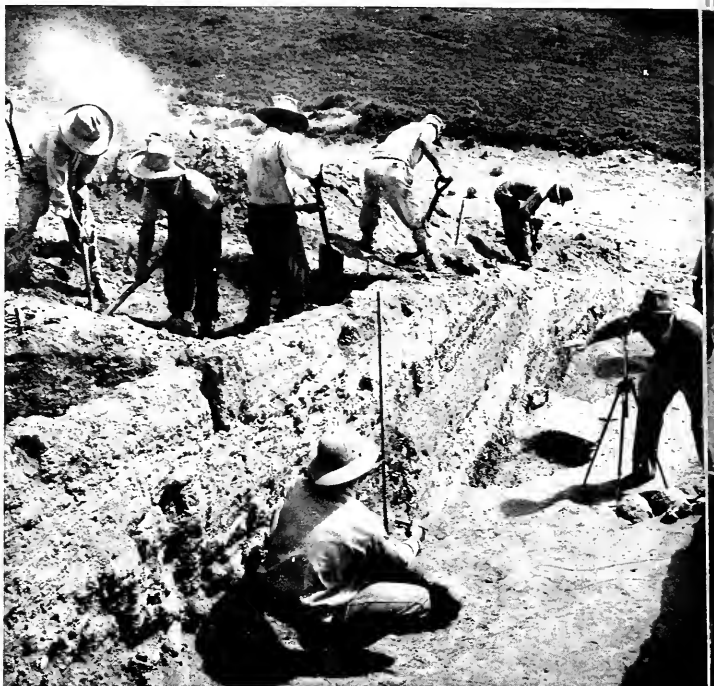
➤ EXPEDITION CAMP, maintained for months beside the Huaca Prieta. In the low areas, limited vegetation is supported by ground water seepage





▲ THE CREW unloading beside an excavation to continue operations

➤ THIS EXPLORATORY TRENCH, dug near the Huaca Prieta, revealed the entrance to one of the many subterranean structures that were uncovered. The men are removing the overlying debris



▲ A COMPLICATED TANGLE of walls and structures are revealed beneath the debris that had accumulated after the abandonment of Huaca Prieta

➤ SUBTERRANEAN HOUSE, with walls of cobbles. Roof timbers, of hardwood logs and whalebones, had been removed at the time it was abandoned, when the surface was at the level being swept by the author.





institutions. Ultimately ten organizations were involved in furnishing funds and personnel, one Peruvian and nine North American. In addition, we had the constant help and valuable advice of the founder of the famous Chiclin Museum, in the Chicama Valley, Rafael Larco Hoyle. He is the outstanding authority on the archaeology of this region, yet he welcomed a virtual invasion of competitors. Each field party operated independently, concentrating on some particular phase of the work to avoid duplication of effort, and pooling the information gathered as the work progressed. It is already clear that the results justified the effort, though until the collected material has been thoroughly studied the full story cannot be told. This account, then, deals only with the one part undertaken by the American Museum—a study of the oldest evidence of human occupation in that area, and it was this assignment that brought me to the Huaca Prieta.

A search of the wind-eroded surface of this mound and the sides of the large crater-like pit dug in its top many years ago by treasure hunters confirmed what my friends, the Larcos, had told me before they brought me to it: that it had accumulated prior to the use of pottery in this part of Peru. The only artifacts to be found were unworked stone flakes and the crudely flaked cobblestones from which they had been removed. Such simple objects, generally classed as "choppers" or "hand axes," occur from Canada to Tierra del Fuego, associated with completely unrelated cultures of varied antiquity. By themselves, they seem of little help in checking the relationship of groups of people or of periods.

More impressive was the complete lack of any evidence of what we call pressure flaking—a technique used in making stone knife blades and spear and arrow points. This technique, dating far back in human prehistory, is so widely distributed throughout the world that its absence is either taken to indicate an extremely primitive culture or to show that the people have advanced to a point where a knowl-

edge of metalworking has made it obsolete. Exceptions are known where people have occupied areas in which suitable stone was unobtainable, but these are limited and easily understood. Once before, along the coast of southern Chile, I had found remains of a simple primitive culture that lacked pressure flaking, and, as far as I knew at the time, it was the only region in America having suitable stone but lacking the technique.

As stone suitable for pressure flaking is available in this part of Peru, it was obvious that the debris at the Huaca Prieta had been left by a people having a culture similar in this one respect to the early Alacaluf of South Chile. Certainly it was a place that could tell us something about the pre-pottery period of Peruvian prehistory—a period of which we knew practically nothing. Of this much I was sure before putting a spade in the ground, though it in no way prepared me for what we finally found.

A similar pre-pottery midden, or refuse pile, had already been located in the Viru by Dr. W. D. Strong, of Columbia University, but as the Huaca Prieta was more promising it was given first choice. A few days after our arrival, my wife and I had our tents set up just beyond the southern end of the mound, our sifters assembled, a crew of ten men engaged, and were ready to begin work. The men all lived within a radius of five miles and, although inexperienced in this type of work, were quick to learn. One, who lived nearest, knew the Huaca as a place where nothing could be found and very considerably advised me that we would be throwing our money away to dig there.

To give the crew practice, we started an exploratory trench beyond the limits of the mound, beginning on the adjacent flat meadowland and cutting up onto the higher dry, barren ground to expose the substructure on which the mound rested. This proved to be a conglomerate rock whose surface was 15 to 20 feet above the limits of vegetation. This was important,

for it meant that the base of the mound was well above the normal flood level of water coming down the valley and that our chances of recovering perishable material in the lower strata should be good.

Carried farther, the trench revealed that the area at the northern base of the mound had been occupied during a period that has been variously named Gallinazo, Viru, and Negative. The last term is based on a method the people used in decorating their pottery, in which a negative type of painting was used to show designs and figures. This culture has been recognized for some years, and although it is known to be respectably old, it flourished long after pottery was first used in Peru.

When a test sample of the debris of this period was sifted it showed that the inhabitants cultivated an abundance of maize and that among a variety of other cultivated plants they had the phaseolus beans, supposed to be of Central American origin. Below this was a hard, sterile layer of what was obviously wind-blown dust that had come from the top of Huaca and settled on its lee side. This covered a hard, consolidated accumulation of beach cobbles free from any traces of human occupation. After cutting down into these for about five feet without reaching more midden, we continued the exploratory trench up the side of the mound to its top. This trench showed that the cobblestone layer continued well up on the mound face and that it became thinner and disappeared at an elevation of about 30 feet above sea level. Beneath it, on the mound slope, was more of the salt-hardened, wind-blown dust from the top of the mound, and under this was well-stratified refuse, dumped there during the actual occupation of the mound.

At first I thought that the cobblestones might, for some inexplicable reason, have been spread over the area by people. But after examining them more carefully, I decided that they must have been left by a tidal wave, an opinion that was supported by a similar deposit ex-



*Photo by Junius Bird*

▲ SIFTING DEBRIS from the lower layers, accessible where wave erosion had sheared off the west side of the mound. The refuse, dust dry, preserved nearly all the perishable material

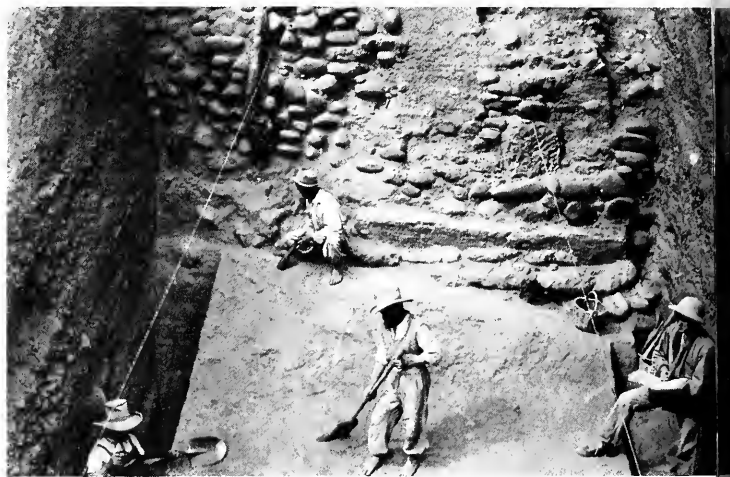
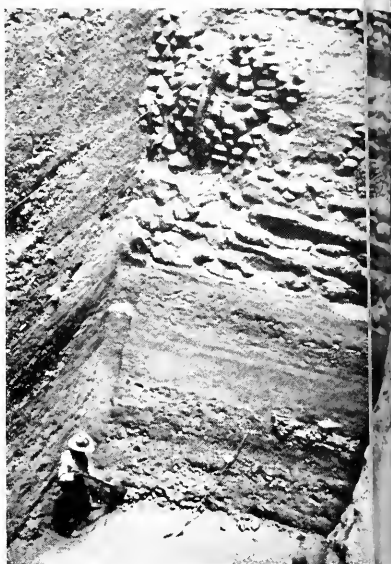
➤ ONE END of the test pit excavated in the Huaca Prieta, with three superimposed retaining walls exposed

posed at the mouth of the Chicama River, two miles to the south. There it was very clear that unusual wave action had carried coarse gravel in from the beach, well above normal storm level and up over soil strata containing evidence of human occupation. This tidal wave, unquestionably catastrophic for the communities near the beach, had little bearing on our problem, for it had clearly occurred some time after Huaca Prieta had been abandoned.

What occasioned the abandonment we do not know for certain. We found that the entire western face had been eroded away by waves cutting back the underlying conglomerate rock. This obviously happened during a period when the relative level of land and sea remained constant. Evidence of this can be seen southward along more than a thousand miles of coast, down into northern Chile, in the form of wave-cut cliffs and barancas in close proximity to the present breach. Subsequently, a slight coastal uplift raised the base line of these above storm level, and they are now, for the most part, protected by more recently formed beaches. Had this uplift not occurred, the Huaca Prieta, as well as many other sites next to the shore, might have been completely destroyed. So perhaps it was the partial destruction by wave action that led to the final abandonment of the site.

At any rate, the erosion simpli-

▼ CLEANING the surface of a layer of debris before taking it to the sifters. The narrow trenches exposed the structure and permitted the accurate separation of layers



*Photo by Junius Bird*

fied our task, for it had left the lowest layers in the mound readily accessible along its western side. For some feet in from the surface, these strata were almost as hard as cement and had to be broken out with sledge hammers and drills. Farther in, the material could be sifted, so we exposed a long block and, following the natural structural lines, sifted it layer by layer. The dip of the lowest layers showed that the first inhabitants had lived on the area west of the existing

mound before the substructure had been cut back to its present position.

We made this test because I was somewhat in doubt as to whether or not we would be able to remove an adequate sample of the debris from near the bottom by cutting down through the total depth of the deposit. Deep pits can be dangerous if the refuse is loose, and in such cases one has to cut the side walls with so much pitch that the area of the pit is greatly re-

duced at the bottom. I need not have worried, for the mound proved to be largely of compact ash, with a relatively small amount of shells. Nearly vertical walls could be cut in it without danger of collapse.

Meanwhile, I had been checking the central portion of the mound and had found that its upper half was filled with a complicated mass of small subterranean structures. Their walls were of cobblestones set in hard mortar, made by mixing the midden dirt with water. The roofs had been of hardwood logs and whalebones covered with stones and midden. The floors were of dirt. In constructing them, the builders necessarily disturbed the stratified debris, mixing artifacts of different ages. To secure accurate chronological data on specimens in such a situation would have required far more time than we could spend. Therefore, as the best place for our main excavation we chose

the part exposed by our first exploratory trench. This was on the northern side of the hill, beyond the subterranean structures, where trash had been dumped more or less continuously and lay undisturbed. Accordingly, we opened a pit 36 feet long and 16 feet wide, with a wheelbarrow trench leading out to the sifters.

Stripping the debris out in layers following the natural strata, we reached the underlying conglomerate 36 feet below the surface at the uphill side of the cut. As the mound is somewhat higher to the south, I estimate the maximum thickness of the compact debris to be at least 40 feet, and that formerly it was at least 5 feet higher. Visitors to the site invariably asked why such a mound had been "built" and were incredulous when told that it had not been intentionally constructed. It had grown through the centuries simply because the people found the location desirable and continued to live there, scattering trash and ashes in close proximity to their houses.

We found four successive retaining walls partly encircling the upper portion. They were apparently built more to extend or stabilize the level top of the mound than for defense. But it was obvious that at no time had any fill or dirt been brought onto the mound. Contin-

ued dumping of trash on the slope had ultimately submerged each wall in turn. From the surface down to the bottom, the refuse was dust dry, with the result that nearly all of the normally perishable material, such as parts of plants and textiles, had survived. In order to make full use of our opportunity, we saved every single item that could tell us anything at all about the life and customs of the people who had lived here.

The resulting collection is most unimpressive by aesthetic standards. There is nothing in it to arouse the envy of the average collector, but it will ultimately, when fully studied, yield a remarkably detailed story. This will require the help of a number of specialists, and as the cleaning and preservative treatment is a tedious process, it may be several years before all the conclusions can be assembled. At the moment, the known facts are worth the telling, even if we cannot fully interpret them.

The excavations verified our first conclusions: that the site had been occupied for a very long time prior to the use of pottery in this region, and that the people who settled here knew nothing of pressure flaked or ground stone tools and weapons. If their stone artifacts had been the only surviving evidence, it would have indicated a



▲ TONS OF DRY DUST were sifted in this way, to recover every item that might add to the story of the ancient people

► SEÑOR MARCHENA sorting the residue which has come off the sifter—a job calling for patience and sharp eyes. Two men were thus constantly employed at each sifter





▲ SEEDS of various plants singled out by the sifters. These may well be over three thousand years old.

◀ SCRAPS of cloth and plant remains collected. With the exception of toy slings, not a single weapon was found.

technological development no better than that of the early paleolithic people of the Old World.

What is most surprising is the fact that from the beginning the economy of the people living here was based on farming combined with fishing. As no evidence of agriculture of comparable age has so far been found in America, the plant remains recovered are of considerable interest. Conspicuous by its absence is corn, or maize, which we later found to have been first cultivated in this area long after the abandonment of the Huaca, by people using the type of pottery known as Cupisnique or Coastal Chavin. The tentative list of cultivated plants, though not yet authoritatively identified, includes squash, chili peppers, beans of possibly four varieties, achira (*Canna*), bottle gourds, and cotton. It is, of course, debatable whether these were all cultivated or whether some were at that time growing wild. The fact that they were regularly utilized by the inhabitants of a well-established community and that none grow wild in the area today suggests that they were all cultivated.

In addition, several wild plants formed an important part of the

diet. The roots of the common cat-tail; tubers of a rush, *Cyperus*, known locally as *papas de junco*; and tubers from a "nut grass" sedge were all gathered and roasted. Fruit seeds show that they ate the *ciruela del fraile*, *Lucuma*, *guayaba*, and others still to be identified.

The balance of their diet seems to have come almost exclusively from the sea. Fishes were caught with nets, for the location is unsuited for hand line fishing. The most satisfactory method today is with seine nets, and this may have been true then, for we found many net fragments and one large seine well down in the mound, with its gourd floats still intact. A limited section of the adjacent beach, slightly protected by an irregularity in the shore line, permits this type of fishing and is, I believe, one of the reasons why the people settled at this particular location. Hand line fishing from the shore is impractical because of the surf, and this is reflected in the lack of hooks in the refuse. That they knew about them is shown by a single fragment of shell hook found at the bottom and several other crude ones of thorn, suitable only for catching the small fresh-water fishes that live

in near-by drainage channels. No spears or harpoons appear to have been used.

Shellfish, because of the heavy surf, are not very abundant on this coast. Apparently there was once a reef or point of conglomerate rock beyond the present shore line, providing a more favorable situation for their growth. This is indicated not only by the structure of the mound but by the fact that the people secured and ate large, deep-water mussels, which are no longer available in the vicinity. These mussels are seldom found in less than three fathoms of water and need more protection from surf than the situation now offers. The frequency of these shells in the midden proves that some of the people were excellent swimmers, for at the places where the mussels are still found, only men equipped with modern diving gear gather them. Sea urchins, crabs, clams, and even starfish were eaten. Occasionally a few sea birds, sea lions, or, less frequently, porpoises were secured. Apparently no land game was eaten, for we did not find any other mammalian remains. Though this might indicate a food taboo, it is more probable that there was no game available at that time.



▲ BACK AT CAMP, items sifted from the debris are sorted for packing



▲ A FIELD RECORD is kept of the number and types of stone artifacts in each layer

▼ PERFORATED net sinker, with one of the hammerstones used in pecking out the hole

Cooking was, to a large extent, done with hot stones, so that an appreciable percentage of the debris consists of fire-cracked cobbles. Utensils were of gourd and perhaps calabash, and of the thousands of fragments of these that we found, only two had carved designs. Sometimes rough lines had been scratched on the soft epidermis when it was fresh, and this might be considered decorative. Pyro engraving, a method of decorating gourd utensils by means of a hot implement, was rarely used, though it became quite common much later, at the time maize was introduced. This early rarity of decoration on such an easily worked medium as the gourd implies a lack of artistic urge which was supported by all our other observations.

A list of their other possessions is astonishingly brief. With the exception of toy slings, we did not find a single weapon. I cannot believe that this was accidental, for we sifted far more debris than is usually necessary to check on the material culture of a group. The people made no beads or ornaments, and the only objects of bone were small bodkins. The only artifact of wood was a narrow,

paddle-like stick, possibly used for digging.

Obviously, we missed some items. For instance, they had fire, yet we found no equipment for starting it. They made bark cloth, yet we found no tools for beating it. They spun cotton, yet we cannot prove that any of the many twigs found were the spindles.

In spite of this dearth of tools, there was abundant evidence that they were skillful with their hands. In all, we must have 3000 fragments of fabrics, all older than any previously found in America and almost all of cotton, with a few of bast. When these have been cleaned, they may give us the most complete picture of a truly primitive stage of weaving recovered anywhere in the world. A field analysis of the techniques used shows that about 78 per cent of the pieces are of twined construction. Netting, in the form of fish nets and pouches, is next in frequency, then looping and coiling, with true weaving coming last.

The technique of twining—uniting warp yarns by twisting a pair of weft elements about them—has long been recognized as very ancient. This has been deduced from its wide distribution and is



supported by archaeological evidence. Twining is found among the textiles from the mud of the Swiss lake dweller sites, but the associated cultural remains there are technically almost as far ahead of the Huaca Prieta stage as modern Swiss culture is from its forerunner.

We failed to recover any unfinished piece of fabric that might

*Continued on page 334*





Photo from National Aeronautographic Service of P

# Cushion Plants OF THE HIGH ANDES

WHEREVER there are mountains, there are alpinists among plants. To them the highest unsurmountable barrier is not the ultimate icy pinnacle but rather the line of perpetual snow; for the snow line, except for certain never-say-die lichens, marks nature's altitudinal "iron curtain" beyond whose frozen folds higher plant life cannot pass and live. The elevation of the snow line on mountains is the factor that determines how high flowering plants may climb above sea level. Of course, the elevation of snow line, like that of timber line, varies with latitude. In the arctic, (and antarctic) snow lies on the ground almost at sea level the year round, at least in protected spots, but as one moves farther and farther south permanent snow either disappears or is limited to the tops of the higher mountain peaks; and as one nears the heat of equatorial regions the snow line, retreating ever upwards, reaches

A trip to the snow line of the High Andes where curious forms of plant life decorate the desert heights

By WALTER HENRICKS HODGE

*University of Massachusetts*

*All photos by the author unless otherwise indicated*

its highest limits. Thus plants in the high latitudes of polar regions cannot possibly try any high mountaineering, but in the region of the equator, they pursue the ever-ascending snow and clamber into the clouds—if there are mountains to climb.

There are, and lofty ranges they prove to be, as a glimpse at any globe will tell. Of these, the highest summits at the equator itself lie in the Andean Cordilleras of our own hemisphere, in western South

America. Ecuador's lofty Chimborazo (20,702 ft.) is the highest peak close by the equator, and she looks down her snowy nose in a relatively short vertical distance from the equivalent of the cold arctic realm to the wet tropical realm, with all the intervening zones between telescoped on her volcanic slopes. A dozen other peaks in neighboring countries match or surpass in elevation this giant sleeping volcano; they culminate in lofty Huascarán, guardian peak of the



CORDILLERA BLANCA, a tremendous snow zone in Central Peru, is the center of the cushion plant country. On the slopes of this "Switzerland" of the Andes, these plants are higher than in other areas

Cordillera Blanca of central Peru. Most of these Andean giants can offer approximately 17,000 feet of slopes habitable to plants; above that mark lie the snowy mantles of glaciated summits. Seventeen thousand feet thus becomes the approximate uppermost goal for alpine plants. What kind of green life do we find at this *ultima Thule*? Why, the cushion company, those curi-

mony with its surroundings that it may easily be overlooked by the casual observer as merely a giant lichen-covered boulder smoothly rounded by glacial action. Moreover, yareta may be clambered upon like a boulder, so solid is its construction. Normally, cushions of yareta are low and spread occasionally to form a great, irregular green platter as much as twelve feet in diameter. At times these platters push up to three feet in height at their center, but this is rather rare.

Kneeling beside a yareta plant, one will observe a living green mosaic of compacted leaf rosettes

each single leafy rosette is actually the terminus of a single hidden branchlet whose leaves are limited to the uppermost tip. Slice a typical yareta plant down through the center, and it would resemble a giant cauliflower head split in two.

The greatest display of cushion-forming species is centered around 14,000 feet and above, in those higher exposed portions of the Andes generally called *puna*, a zone where conditions are often dry and desert-like. In fact, the Andean *puna* might be called one of the loftiest desert regions in the world. The cushion form is the end product of the dwarfing influence of a mountain environment, which has brought into being a practically stemless plant with oversize roots that help to hold the foliage and flowers close to the soil, as though fearful of what the elements might be able to do if these parts were raised too high above the ground. The seasonal aridity is one of the important reasons why many alpine plants have been forced to adopt the cushion form. By crowding leaves tightly together, thereby offering a minimum of evaporating surface to the elements, moisture—that all-important ingredient of the green factory we call a plant—can escape only with difficulty. *Azorella* further protects itself, as do so many other desert plants, by covering its vegetative growth with impervious resins. This protective natural varnish further cuts down evaporation from the green tissues and enables them to hold the water like a sponge.

The desert condition is not the sole chisel used by nature in sculpturing a cushion plant, else this type would be found in all deserts. There are other chisels, one of which is temperature, which falls to low levels at increasing elevations. Above 17,000 feet it remains below freezing most of the time. Even on the *puna*, freezing temperatures are common especially at night. No plants grow well when the thermometer hovers so low. Our own spring flowers pop only after a succession of warm days. Cushion plants hug the soil. At first, it appears strange that at higher



▲ GREAT TUMOROUS MOUNDS of yareta in southern Peru

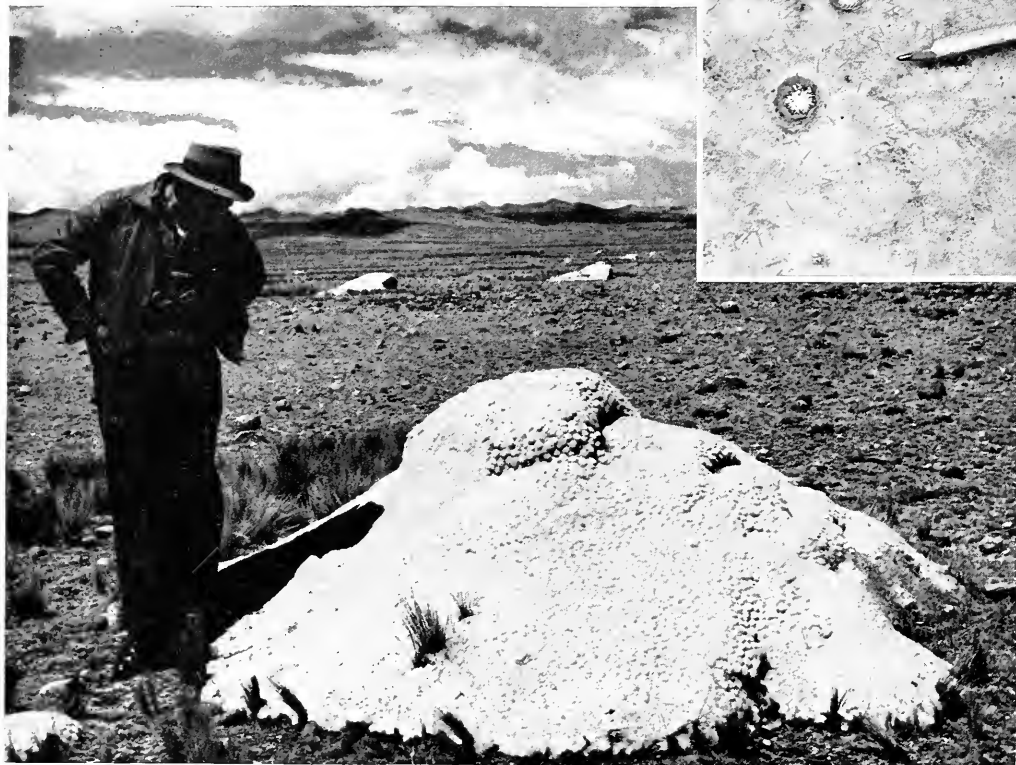
ous amorphous mounds of greenery which mimic the very companion rocks and boulders of their substratosphere environment.

Let's look at yareta (*Azorella* spp. of the Umbelliferae), a close relative of the garden carrot and a typical cushion plant of the high Andes. It does not take much imagination to see why it is so called, for an individual of this curious species may form a gray-green, often tumorous mound of compacted verdure that is so in har-

mon looking for all the world like diminutive, if crowded, editions of the familiar "hens-and-chickens" of the home rock garden. But unlike these plants, the flowers of yareta are insignificant (hardly an eighth of an inch in diameter), and one has to look closely even to notice the tiny greenish-white blooms that speckle the great cushions during the May to July flowering season. Hidden beneath the gray-green leafy mosaics are highly-branched but remarkably telescoped stems; in fact,

▼ THE LARGEST CUSHION forming cactus of the *puna*, *Opuntia lagopus*. It is probably the most "stratosphere-minded" member of the whole cactus family

► *OPUNTIA LAGOPUS* CLOSE-UP, showing three yellow flowers sunken in the felted mat that covers the prickly, hidden stems of this amazing cactus



elevations, when given the choice of rocky or nonrocky sites, they often choose to grow on great piles of boulders. Close to the ground, the great cushions can soak up the warmth of a soil heated up by an equatorial sun whose perpendicular rays, passing through the seasonally clear and rarified atmosphere, are far more intense than at sea level. The jumbled rocks and boulders of the *puna* stone fields, unlike the bare areas of the *puna*, are the great natural radiators of this bleak expanse, absorbing the solar heat during the day and holding it longer than does the open soil during the night. Only around the rocks, then, is there sufficient continual soil warmth for the growth of cushion plants.

The resin that covers the yareta cushion so efficiently may be the

undoing of this species, for in the high, treeless areas where it has long thrived, ordinary firewood is absent and yareta has been the only available substitute. It is an excellent pinch hitter, for as the cushion dries, the resinous material oozes from it, making the plant highly combustible. The Sierra Indians have long used the resins, obtained from burning the green yareta, as astringents and absorbents in their home medicines, while the ashes are utilized as fertilizer. Fuel from dried plants has been shown to evolve an enormous amount of heat with the production of little or no smoke. The exploitation of yareta has thus proved to be a good thing for the *puna* herdsmen, who annually collect their supply of the cushions three months before needing them and stack them

to dry like cordwood outside their stone huts, and also for big business, especially within reach of railroads. Stacks of yareta, piled high along the tracks, are familiar sights at certain trans-Andean railway stations.

*Yaretals*, areas abounding in these plants, are fast disappearing, especially within reach of railroads. In a good yareta, from ten to fifteen per cent of the ground is covered with plants, with an average of 280 to 420 plants per acre. At the present time the richest area of yaretals lies in the western Andean Cordillera near the Chilean-Peruvian frontier, where there are an estimated 200,000 acres of plants. Harvesting takes place during the dry season, and the plants are handled like peat. Fortunately the Peruvian Government, recognizing the fact

that this slow-growing plant may become extinct, has taken steps to guard against the heretofore unbridled exploitation.

Like many another American desert, the "skyscraping" South American *puna* has representative cacti which, like their more familiar cousins of our Southwest, are outstanding oddities among their companion plants. The well-known genus *Opuntia* is most commonly seen in the higher Andes and is probably the most stratosphere-minded of the whole cactus clan. Like yareta, this genus will grow right up to snow line. Certain species of cushion cacti, like *Opuntia ignescens*, fraternize with *Azorella*, but the larger cushion-forming types of cactus—which vie in size with the cushions of *Azorella*—seem to prefer the company of bunch grasses on the high *puna* prairies. These areas, which are the favorite grazing grounds of the alpacas and vicuñas, are subject to frequent snow flurries, and the snow often lingers in scattered patches. At such times, cushion cacti and snow patches are almost indistinguishable, for the two commonest species, *Opuntia lagopus* and *Opuntia floccosa*, are covered with snow-white, feltlike hairs. These serve the same purpose to these cacti as does the resin of yareta, keeping

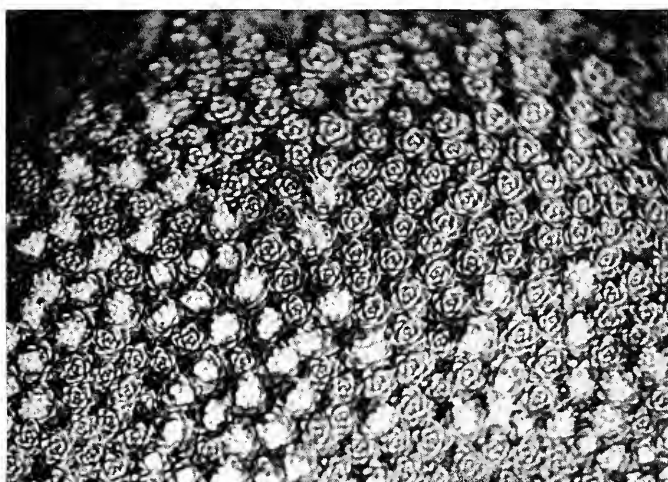


▲ *OPUNTIA FLOCCOSA*: a surface of the plant, which looks like a loosely-woven, woolly pincushion. Several flowers are visible

the inner part of the cushion nicely moist and thus protecting it against the ever-prevalent drying winds, which race, unchecked by trees, across the forbidding wastes of the

high *puna* plateaus. *Opuntia lagopus* is cactus-like only in its tiny yellow, typically cactaceous flowers, which peer from the dense camouflaging wool of the cushion. Otherwise, this species is an aberrant member of its family, with branches packed as closely into its highly convex but woolly cushion as are the branches of *Azorella*. One can likewise stand upon this firmly packed mass, but if you think that the mat is soft to the touch, beware! *Opuntia* cushions have hidden spines and thus are more than plant cushions—they are plant pincushions! *O. floccosa* and *O. lagopus* are friendly associates on the *puna* and are similar in shape and color of flowers, but the former species makes smaller cushions, in which the individual hairy branches are more loosely packed.

*Azorella* and the companion species of *Opuntia* constitute an unusual trio, representing the acme of high-climbing, cushion-forming plants in the Andes and possibly in the world.



▲ CLOSE-UP OF YARETA CUSHION, showing the tiny compacted leaf rosettes interspersed with insignificant flowers



▲ A COOT and his reflection on Lake Eola, Orlando, Florida. Note the large feet, which can project outward from the body, permitting greater freedom of movement

WHEN you view a coot at close range for the first time, it looks like a composite wild fowl. It swims and dives like a duck and bobs its head like a pigeon. It has a sharp bill somewhat like a chicken's and even a sharper disposition. Definitely, the coot is a bird of contrasts in both appearance and behavior.

At a distance the coot appears to have uniform dark gray or almost black plumage, depending on the light. But at closer range one will notice that the gray plumage varies considerably on different parts of the body, being darker on

## COOTS *are* Clever

Mud hen, blue Peter, sea crow, splatterer, water chicken, crow duck—whatever the name you'll like these friendly but independent water fowl

By HUGO H. SCHRODER

*Photographs by the author*

the head and having a decidedly olive tinge on the back. It has red eyes, a white bill with a few reddish marks, greenish-olive feet and legs, and white feathers on the under tail and wings.

Coots are often mistaken for ducks, but actually they belong to an entirely different family—the

rails and gallinules. Whereas ducks are always web-footed, the coots have large lobed toes. Their voices, too, are entirely different, and instead of waddling, they often walk and run. The coot has been well provided with local names, ranging from the familiar mud hen to sea crow, and including blue

Peter, marsh hen, splatterer, water chicken, flusterer, crow duck, and pulldoo (from the French *poule d'eau*, a moor hen or gallinule).

H. K. Job states that the coot should be credited as the originator of the "mud hen skitter" dance, which the birds perform on the surface of the water. Before taking off for flight, they skitter over the surface for a considerable distance.

pushing with their feet against the water to gain momentum, as some large birds do on land. Coots literally run on the water, churning up the surface in their wake as they take wing.

Usually, however, the coot does not leave the water even when in danger but escapes simply by skittering over the surface. Cruising through Florida's rivers and lakes,

you may disturb the birds in fairly open water, but they will still rely on their ability to reach sheltering vegetation without taking flight.

The range of the coot is wide. Its principal nesting grounds are in regions beyond the Mississippi River, although some nest in the eastern states. I saw many coots, for instance, in the marshlands of Bear River Wildlife Refuge in Utah. They frequently build a floating nest of the available vegetation, anchoring it to the reeds to prevent its drifting. The number of eggs may vary from six to twenty, but the average is around a dozen.

In winter the coots range eastward in great numbers. They frequent the marshy borders of central Florida's numerous shallow lakes and streams, and many are seen on Lake Okeechobee. Certain areas of this lake, miles from shore, are like huge marshlands, the water being



◀ MEALTIME on the lake is whenever a spectator makes an offering. Here two coots and a lesser scaup reach for a scrap of bread

▼ COMPETITION among the coots and the scaups for food thrown into the water accounts for this lively commotion





only a few feet deep and covered with a dense growth of vegetation. A sort of canal extends for miles through the marsh vegetation, forming a waterway through which boats can pass without difficulty. Coots flushed here do not have to move far to gain the shelter of vegetation.

An unusually large concentration of wintering coots is always present on Lake Apopka, in central Florida. At various times I have estimated that 50,000 or more were visible from the shore, although the view included only a small section, for the lake is more than 15 miles across in some parts. When fishing boats move about they momentarily disturb the hordes, but the birds move only a hundred feet or so and then settle down as if nothing had happened.

In Orlando, Florida, there are two lakes near the center of the town where hundreds of coots spend the winter, along with numerous lesser scaups, ring-necked ducks, gulls,

grebes, cormorants, and some ruddy ducks. Lake Eola is surrounded by a public park from which residents and tourists watch the antics of the coots as they disport themselves in the water and call to each other in their strange voices. Their repertoire is extremely varied, including an assortment of noises such as grunting, croaking, squeaking, and squawking, with some sounds like a creaking hinge or a froglike *plunk* thrown in for good measure. They call frequently during the day and even keep up their unmusical noises at night.

When the first coot contingent arrives at Lake Eola in October, the birds shyly remain at some distance from shore. Before long they venture closer, and within a few weeks they seem to lose all fear of man. They clamber on shore, either standing in the sunshine or squat-

ting on the ground as they rest. When food is thrown to the ducks in the water, the ubiquitous coots are on hand to claim their share of the free lunch, and they manage to snatch up morsels before the ducks are able to grab them. On land, they amble about, snipping blades of grass like so many chickens and searching for stray bits of food they may have overlooked.

By mid-winter the coots walk about on shore quite unafraid of the people in the park. Groups of the birds gather to rest in the shade of the palm trees bordering the walks, and often a score or more may be seen only a few feet from passing pedestrians. If someone sits on a park bench near the water, the coots nearby are immediately on the lookout for possible handouts. If food is forthcoming, a dozen to fifty or more birds soon

▼ **BRIEF ENCOUNTER:** a coot and a male lesser scaup (bluebill) eye each other with apparent unconcern on Lake Eola, which they share during the winter months







▲ Two coots poised for action with the defiant stance of barnyard roosters

gather. Several times I have been able to touch them as they came for food, and some of them would take pieces of bread from my hand regularly.

It is a thrilling experience to see a truly wild bird lose all fear of man. Anyone who has not seen coots in their winter homes in protected regions would be inclined to doubt that this wild bird could so completely change its habits in such a short time. Man is responsible for much of the wildness of our native birds but can regain their faith by kindness and patience.

When two or more coots congregate in or out of the water, signs of an argument are soon apt to appear. One bird may chase another over the water, driving it away from the feeding area; or two birds may face each other in the water

like a pair of angry barnyard roosters. During a fight I have sometimes seen a coot on its back in the water with both feet brought into play.

Ring-billed gulls, always on hand when the birds are fed, are a threat to the coots' free food supply on these lakes. If a coot manages to grab a whole piece of bread, the gulls swoop down to snatch it away. The gulls are so persistent that the only recourse for the coot is to dive underwater with its booty, but the gulls are ready to grab the food as soon as Mr. Coot emerges.

Over the years I have noticed that the wild coots that come to the Florida lakes spend about six months there. They usually arrive in October and leave during April. In mid-April there comes a morning when the surface of Lake Eola is bare of coots, with the possible exception of a few stragglers that remain all summer. The day before, hundreds of the curious looking birds were present, but sometime during the intervening hours, the travelers took off for their northern breeding grounds. Seeing the bare expanse of water, one feels as if many old friends have left without saying good-by. During the coots' stay in Florida, their antics have served to make life pleasanter for many people, who look forward eagerly to their return when October rolls around again.

▼ COOT NEST among the reeds: a photograph taken in the Malheur Wildlife Refuge in Oregon. Eggs vary in number from six to twenty, but the average is around a dozen





▲ THE WHARF is lined with stockaded pens for fishes under study. Bimini was chosen for its unusual research opportunities

SOME considerable time ago this author leaned anxiously over the well of a glass-bottomed boat and peered at the coral reefs a few fathoms below. The anxiety was not occasioned by the gaudy-colored, lunar aspect of the submarine landscape or by fear that the plainly visible inhabitants—sharks, morays, sting rays, great, ominous fishes, and tens of thousands of smaller, macaw-bright fishes—endangered the craft and its company. It was the anxiety of one who waited for an opinion from his peering companion, Dr. Charles M. Breder, Jr., Chairman of the Department of Fishes and Aquatic Biology at the American Museum of Natural History.

After some minutes of glass-bot-

tom espionage on the coral jungle, Dr. Breder raised his head and couched an important judgment in nonscientific language. "Good gosh!" he said.

It summed up his appraisal of the isle of Bimini as a suitable site for marine research. He looked

again and went on talking: "There goes a—oh, well. It's so rare, it hasn't a common name. Look at those groupers! Those are the big-gest porkfish I ever saw in my life!" He smiled his wry, boyish grin, and his eyes were bright with scientific excitement. He identified more rare

\*PHILIP WYLIE is known to millions of readers through his books *Finnley Wrenn*, *Generation of Vipers*, and *An Essay on Morals* and through his stories of fishing. His passion for fishing grew into an intense interest for the scientific problems of the sea. He is now one of the four members of the Advisory Committee of

the Marine Laboratory he describes in this article. If asked what his connection with Museum affairs is, he may modestly admit to having written a murder mystery that had its setting in the American Museum of Natural History, but his intellectual attachment to Museum affairs is far broader than this.—Ed.



fishes by their common names—an ichthyologist “slumming” for the benefit of us laymen.

On the other side of the glass-floored “well” in our boat sat Michael Lerner, American Museum trustee, big game hunter, world-famed angler, and a collector of many valuable specimens of the earth’s fauna. “Think it’s the best spot?”

Dr. Breder looked to his right, where the reef slanted down to the abyss and where the gigantic, purple Gulf Stream poured eternally north. Then he looked back and over his left shoulder at the low, palm-fringed sky line of the two big islands and the many small islets that constitute Bimini, in the British Bahamas. He spoke musingly:

“You’ve got coral sand beaches here—miles of them. You’ve got

aeolian limestone outcrops. You’ve got every known depth and a vast variety of life. Bimini is part of the Great Bahamas Banks. Half the islands are mangrove tangle—with all the additional biology that means. You’ve got that big, almost landlocked bay between North and South Bimini Islands. It’s like the lagoon of a coral atoll. Then—” he took a slow breath—“the Gulf Stream flows practically at your doorstep. Pelagic life—plants—the eggs it carries—and the unknown living things in its depths: its mysteries. Why—there even used to be a fresh-water pond on South Bimini—and it could still be restored, I think, so you’d have a fresh-water cross section of things, too. Man—it’s a paradise for marine study—and a lot of other study, besides!”

Mike Lerner grinned. “Then we’ll build the Lab here on Bimini!”

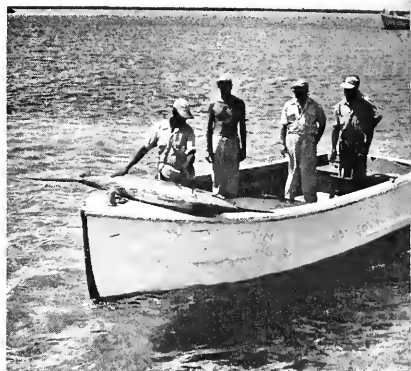
A long and careful search was ended in those few minutes—and a large and difficult undertaking was initiated. It started out modestly. It grew as newly-seen opportunities suggested additions and ramifications. It is today the Lerner Marine Laboratory, a field station presented to the American Museum of Natural History, and it was dedicated last March by Sir William Lindsay Murphy, Governor of the Bahamas. It is growing in scope and equipment every day. More than \$100,000 have been invested in the buildings and the plant. A large endowment, made by Mr. Lerner and others, is being swelled by constant contributions from persons of varied but related interests. It is



*Photos by Sound Masters, Inc.*

▲ A CONFERENCE on the Laboratory ramp.  
Left to right: Dr. Gregory, Dr. Nigrelli,  
and Michael Lerner

► A DIVER submerging to take underwater  
motion pictures for a special study that is  
in progress



▲ THE LABORATORY WORK BOAT  
bringing in a marlin for study





► MICHAEL LERNER, founder of the Laboratory, with Sir William Lindsay Murphy, Governor of the Bahamas, and Albert E. Parr, Director of the American Museum: the dedication ceremony



Photo by Freddie Mawra

▼ THE ADVISORY COMMITTEE: (left to right) Philip Wylie, the author; Michael Lerner; C. M. Breder, Jr.; and Arthur Gray



Photo by AMNH

unique—as is its founder and donor.

Michael Lerner is a successful American businessman who took an early interest in hunting and fishing—an interest which became increasingly scientific, as it does with many persons. He is a man of average height. And, with those statements, all resemblance to the ordinary and the average ends. He is a man of Herculean strength, with grey eyes—and sandy hair that sometimes looks like the mane of

one of his leonine trophies. For he is usually too busy to see his barber. Intense in action, he is quiet-voiced in conversation—and informal. Thousands of people call him “Mike”—all kinds of people—all over the earth.

He hunted and fished and thus gathered some of the finest specimens ever taken from the field and the sea. He held several angling records—world records. But he changed from a hunter into a col-

lector—and from an amateur collector into the organizer of numerous scientific expeditions to Chile, New Zealand, Australia, and elsewhere. He organized the International Game Fish Association—housed in the American Museum—to keep track of record salt-water catches, to bring the anglers of the world together, and to promote a scientific as well as a sporting interest in fishing. He made himself ineligible to hold records. Active in many Museum affairs, he long dreamed of establishing, somewhere in subtropical waters convenient to the United States, a research laboratory. None such existed. And constantly, in his own experiences, he ran up against unsolved marine enigmas. Inquiry into these only revealed the existence of myriads of like mysteries awaiting scientific study.

Dr. Breder, along with other experts, helped in the search for the ideal site. And Dr. Breder, in addition to his Museum duties, is now head of the Laboratory, which is also served by an advisory committee comprised of himself, Mr. Lerner, Mr. Arthur Gray of New York, and this author.

To visualize the Lerner Marine Laboratory it is necessary first to see with the mind's eye Bimini it-

self and to know a little about life on Bimini. The north island, which houses nearly the whole population of the group, is some six miles long but only two or three hundred yards in width. About seven hundred people live here. Most of them are Negroes. Their pastel-colored homes, markets, shops, and open bazaars straggle along the inland water front and rise up on the "spine" of the island, which has a maximum elevation of perhaps 20 feet. Buildings along the summit face the open sea. The British flag on the Commissioner's Office flies highest here—against the warm, blue sky and the regimented clouds of the Caribbees. Next are the two-bladed windmills widely used to generate electric power—and next, the tops of tropical trees—palms, royal poincianas, ficuses, and the like. Beneath these are the sun-drenched houses surrounded by shrubs—sweet-scented and forever in bright bloom.

Bimini is almost never cooler than sixty degrees even in mid-winter or warmer than eighty-five in midsummer. The prevailing wind is called a "trade" and comes from the southeast. Lush, green, flower-

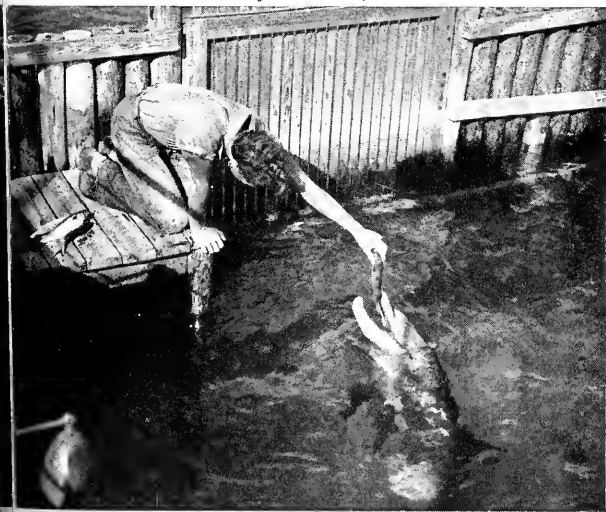
spangled, and house-dotted, the inhabited island is wrapped partly around its "lagoon," and the opposite side is nearly enclosed by South Bimini. From the houses—with their vegetable patches, miniature banana groves, and tall coconuts—rickety piers finger into the bluest water on earth. Capri cannot offer more profound colors or blues in such variety. Alongside these piers are crawfish pens; and upon larger but still somewhat ramshackle docks, fishing boats—unchanged in design for centuries—deposit their catches of spiny lobsters, turtles, fishes, and the pink pyramids of conchs.

It might be 6000 miles from anywhere. Actually, it is 60 miles east of Miami and the facilities of a

modern city. A few hours on a sleek, twin-engined, sports-fishing cruiser and a few minutes by the planes of the charter air lines. In the "lagoon," the archaic sailboats of the native fishermen make a dramatic contrast with the latest thing in amphibian planes and the glittering ranks of the cruisers of sportsmen who come here in quest of tuna, mako, marlin, and a hundred other prizes.

Hotels—modern hotels with inner spring mattresses and a nonnative bill of fare—serve the sports fishermen and provide revenue to the island. The palmiest and only notorious days of Bimini, of course, were those of Prohibition, when people came to enjoy forbidden fruit juices and when the fast boats

*Photos by Sound Masters, Inc.*



▲ THE PORPOISES, "pets" of the Laboratory, will rise for anyone who will feed them

► A SHARK swimming among other fishes in one of the larger enclosures



▲ FLOODLIGHTS illuminate the stockades, permitting studies to continue after sundown

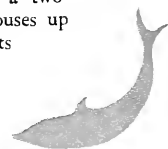






◀ THE "RESIDENCE," a two-story building that houses up to ten visiting scientists

Photos by Sound Masters, Inc.

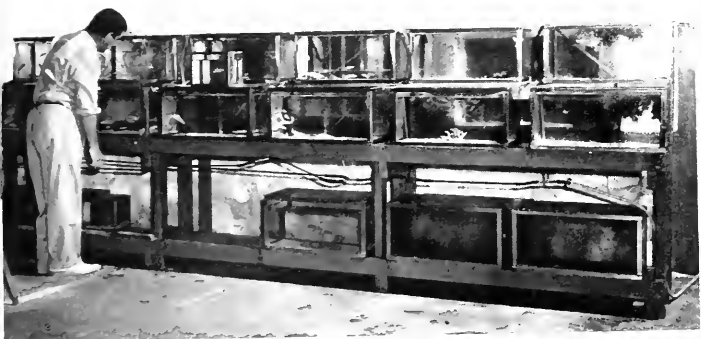


of rumrunners thundered in the velvet nights. But a change in American law put an end to that delirious era—and a hurricane destroyed the flimsily-constructed hotel which served Bacchus. Commercial fishing, the taking of crawfish, guiding, conch-gathering, the making of straw and shell products, and the tourist business are now the sources of Bimini income.

This is the scene, then—the romantic "South Sea Island" background of the new Laboratory. Coconuts, oleanders, frangipanis, and other hot-country flora orna-

ment the acres of its lawns. The Laboratory itself is strongly built—against the annual late summer and early autumn hurricane threat—of coral rock, concrete, and white clapboard. The Laboratory pier extends far into the "lagoon." Its glass-bottomed boat is tied up at the pier. A second, collecting vessel is under construction near by. And a long, sloping cement ramp leads from the pier into the Laboratory—so that big fishes and other creatures intended for dissection may be hauled in from the sea on hand-trucks, without lifting.

The first room in the Laboratory is a combination of library, lounge, and reception chamber. It even has a fireplace—against the rare days when the temperature drops to what is locally considered as an icy sixty degrees. The library—now being compiled—will eventually furnish all the standard works on the flora, fauna, climate, oceanography, and other established data of the area. It will also contain reports of the new findings as they are made by the field station. Behind the library is a large room equipped for gross dissection, with suitable implements, tables, storage closets, and so on. Next is a room for minute dissection, microscopy, staining, preserving, and the like. Alongside this is a darkroom for photographic and special biological work. And behind these is a large chamber equipped with tables, work places, more microscopes, centrifuges, and a wall banked with small aquaria supplied with a continuous



▲ AQUARIUM TANKS for studying smaller fishes. Salt-water pumping apparatus is necessary equipment

▶ DR. ROSS NIGRELLI of the New York Zoological Society, with Michael Lerner and Dr. William K. Gregory, the well-known evolutionist



▶ RESEARCH in parasitology is among the many projects being pursued at the Lerner Laboratory



flow of fresh, filtered salt water through a nonmetallic pumping and piping system.

In these dozens of glass tanks a multitude of weird and little-understood sea creatures is already under study. The proximity of crystal-clear, tidal water makes it possible to keep alive specimens which have always hitherto perished soon after capture. And the glass tanks are supplemented by a bank of concrete pools, much larger in size, just outside the door. Already renowned is the octopus which, put in these concrete pools, repeatedly climbed out and went for a walk on the Laboratory lawn until, one somber day, it walked so far from the artificial duplicate of its natural

his work. The Residence is a large, airy, two-story building with screened porches and a view of island and lagoon. The meals served here are excellent. No research worker is obliged, however, to make use of these gratis accommodations and services. If he prefers, he may lodge himself and obtain his meals at the local hostels, where rates are reasonable.

Alongside the Residence is a storage structure which contains the mass of bulky gear on hand for specimen collecting. This includes nets and trawls of all sizes, lines and hooks, spears, harpoons, traps for various kinds and sizes of seawdwelling creatures, lighted traps, submarine lamps, diving helmets

sands of fish and other marine animals, ranging from the glamorous angels and rock beauties to a live porpoise. Such fishes as are seen at the famed Marineland are seen here, too—a large manta ray, for example, and most of the familiar reef denizens: amber jacks, groupers, barracuda, and so on. But here, also, are the rare African pompanos, and here, for the first time so far as is known, dolphins have been kept alive in captivity. As these words are being written an attempt is being made—with every good prospect—to bring alive into these pens one of the gigantic, migratory tuna which surge past Bimini in millions each spring.

The unusual clarity of the water around Bimini—the bottom may be seen on a calm day in minute detail to a depth of 80 feet or more—gives an unparalleled opportunity for the direct observation of fish behavior and fish social life. But the extensive stockades bring this chance right to the researcher's feet. The only difference is that fishes—even the great game fishes—when placed in such pens swiftly become tame. Dolphins, for instance, took food from the hand after only three or four days of impounding. Their vivid colors have not changed. They still leap mightily and threaten thus to escape—but their apparent voracity and wildness has vanished. They are virtually pets!

What is being done—or is going to be done—at the Lerner Marine Laboratory? The answer may be seen in the alacrity with which applications for invitation were received as soon as the mere rumor of it spread in scientific circles. These requests came in floods. At present, a large variety of projects by many scientists—sixteen from the American Museum alone—are in work or to be started soon. Inquiries have been coming in from universities and scientific institutions abroad. Even before building was completed, some researchers had arrived and gone to work!

Studies have been made on algae in the region; a cursory investigation of small invertebrates in the area revealed the existence of literally hundreds that were as yet



habitat that it could not stroll back—and perished on the grass. A place where octopuses amble about in the gardens is quite a novelty!

Connected with the Lab by a concrete walk is the Residence. Here, ten research workers at a time may be accommodated. Their bed and board is free. Even their laundry is done free of charge. Any scientist from any nation may apply for residence. If he is invited, his only costs will be those of transportation and of any special apparatus, not available at the Lab, which he may wish to bring for

and equipment, tackle for heavy specimens, boat accessories, and so on.

The most popular adjunct of the Laboratory to date, from the standpoint of native and tourist interest, is a series of large pens built by Mr. Lerner for the purpose of maintaining, alive, specimens too big even for the Laboratory pools. A broad wharf with metal railings furnishes access to these pens; batteries of lights illuminate them, when desired, at night. Here, in some half-dozen partitioned stockades formed of piling, live thou-

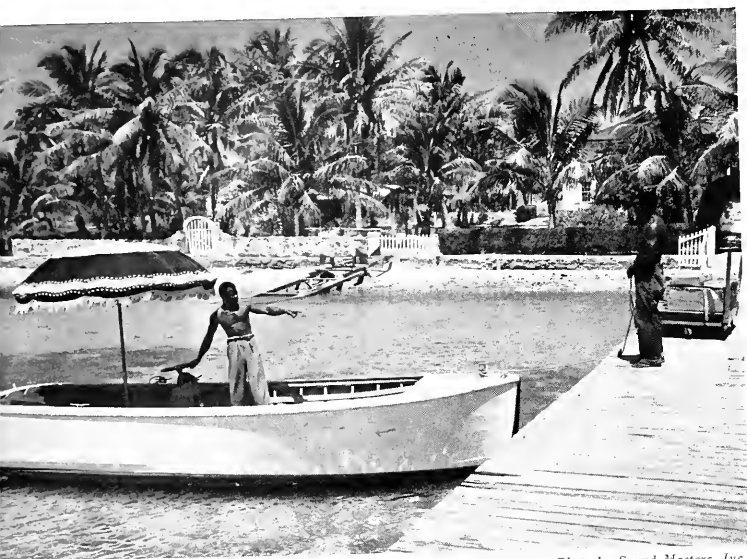


Photo by Sound Masters, Inc.



▲ ONE of the boats at the Laboratory dock. Laboratory building is visible in grove of coconuts

unclassified; an eminent neurologist has already finished one inquiry into the relation of nerve structure to behavior—a field in which certain fishes are particularly well adapted as study material; a noted botanist is engaged in collecting the flora of Bimini and has already found many scores of plants not hitherto reported from the region—including one handsome, two-foot orchid plant now blooming in the Laboratory grounds.

The incidence of tumors in fishes, tumors resembling various human malignancies, coupled with the fact that fishes lend themselves so well to so many kinds of observation, experiment, and control—taken with the further fact that all sorts of fishes abound in Bimini and that the means for elaborate scientific inquiry now exist there—has led to intense interest in the Laboratory on the part of various cancer research groups. It is expected that scientists in this field will soon be working in the Bimini station—and it would be less than normal if the donor and the sponsors of the Laboratory did

not hope that its facilities would contribute to the collection of those bits of knowledge which, one day, will solve the cancer riddle.

When Dr. Breder is asked what work will be started in the months and years ahead, a paradoxical expression comes in his eyes—an expression half of enthusiasm and half of “confoundation.” He looks across the Laboratory gardens toward the sea. “There’s more going on out there that we don’t understand than we do. We’ll look into it as it comes and as capable lookers-in arrive here. We can take only ten scientists at a time. But, if we had the room, the funds, and the equipment, we could keep a

thousand hands busy indefinitely.”

He shrugs. “It’s like Ali Baba after he found the password. He said, ‘Open, Sesame’—and went into the cave of the 40 thieves—and then just ran around looking. That’s our first job—trying to classify things. Finding out what’s here that we know—and that we don’t. Then finding out what needs to be known about all this. We want to collect and investigate pelagic eggs. To study fishes associated with drifting Gulf Stream weed. To learn the histories and breeding habits of dozens and hundreds of species of fishes—where the knowledge is scanty, incomplete, even nil. Tarpon, for instance—between the larval and adult stage. No dope on it, at all—and Bimini has its private tarpon supply. Naturally, we’ll want a permanent collection of reference specimens—two, in fact—one for the Lab and one for the Museum. We need to learn the relation of hydrographic data to abundance and distribution of fauna.

“Then—plankton is relatively scant here—which is why the sea is so crystal clear. Life is abundant—but it builds itself up largely from attached growths on the sea bottom. That needs study. Differential social behavior of reef and pelagic fishes needs more illumination—and this is the place to seek it. More work needs doing on fish locomotion.” He turns to the application cards and leafs through them. “Study of the taxonomic status of fixed larvae—reaction of pigmentary systems—social attitudes of fishes—significance of patterns in reef fishes—”

Photo by Freddie Maura



► SEA TURTLES: Above, a hawksbill; below, a green turtle

He shakes his head. "No end to it! And here's another thing. The natives on this island are nice people. They bring us everything they imagine might interest us. A lot of it does, too, believe me! But they aren't making the most of their economic chances—with this ocean in their yard. We're going to have men here who have seen every sort of commercial fishing on earth. I hope we can find Bimini some new industries—as a *quid pro quo* for the hospitality of the people and the government. Catching flying fish in trick sails for the dinner tables of Miami, for instance. Or maybe collecting algae for agar. Those big tunas—you can't hold one on a rope—they tear the end out of your boat—but the Italians trap them. Lots of good possibilities."

It looks as if the Lerner Marine Laboratory would be busy! It looks as if the knowledge of all men would be constantly enriched by its existence—which, of course, is why it has an existence. New projects are suggested every day. New experts arrive every few days. New applications pour in. New and ever more ingenious equipment is designed and used. New problems come up and are solved by new methods.

Sixty miles from the traffic-jammed, roaring mainland of the U. S. A., on an island that looks more "South Seas" than the most glamour-dazed Hollywood director could ask, microscopes come to focus, nets dip into the sparkling sea, submarine lamps probe murky-blue coral caves, sections of tissue are stained, notes fill myriad books, great fishes yield secrets to expert dissection, the ocean is sampled by test tube, the air is metered, the plants are classified and preserved, and the welfare of man is advanced by a scrutiny of the behavior of fishes, or their diseases, or what-not. Science, in sum, is seriously at work.

All of this came into being because a young man named Mike Lerner, who went out with a rod and a gun for a bass and a bird, kept seeking bigger game until he wound up on the trail of the biggest quarry in the universe: knowledge.

# Natural History

## CRYPTOMAZE

By EDWARD DEMBITZ

### Part I

In this test you are given a set of definitions, each with a set of blank spaces, and a diagram to be filled in. Each definition is a clue to a word whose letters you are to insert in the blank spaces preceding the definition.

- |                        |  |
|------------------------|--|
| 11 7 18 12 18 4        | <i>Sacred Coleoptera of ancient Egypt</i>  |
| 23 8 14 18 15 3 18     | <i>World's largest active volcano (Hawaii)</i>                                   |
| 17 14 18 19 23 16 5 19 | <i>Minute water organisms: food of the right whale</i>                           |
| 4 13 18 21             | <i>Anthropologist; curator at the American Museum of Natural History 1901-05</i> |
| 12 13 21 3 9 9 18      | <i>The stone that made possible translation of hieroglyphics</i>                 |
| 15 19 8 7 13 12 19     | <i>Mythical one-horned animal</i>  |
| 7 6 2 24 3 12          | <i>French naturalist (1769-1832); founder of comparative anatomy</i>             |
| 2 5 14 22 21           | <i>Name for meadow mice in England</i>   |
| 20 6 11 23 22 25       | <i>A tussocky peat bog of northern Canada</i>                                    |
| 24 25 15 18 19 18      | <i>A tropical American lizard used locally for food</i>                          |
| 10 6 3 4 14 13         | <i>Southwest American Indian</i>   |
| 11 14 5 9 1            | <i>A mammal that lives upside down</i>   |

### Part II

When you have filled in all the letters above, transfer them to the proper numbers in the boxes in the diagram below.

When the diagram is completed you will have a word maze containing the names of **FIFTEEN TREES**. To find these trees, begin with a letter and move from space to adjoining space in any direction, including diagonally, until a name is spelled out.

Answers on page 334

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Copyright 1948  
By Edward Dembitz



AMNH Photos

▲ THE CAROLINA TOAD, which was tested against natural obstacles in tests to study its homing ability. Knobs back of eyes distinguish adult Carolina

A FEW years ago a story appeared that described how a toad traveled ten miles to return to its native garden in Wakefield, Massachusetts. Moreover, the toad allegedly did so in less than 20 hours after being carried across Boston on a train.

Following its release the leaping amphibian was watched as it turned a corner and crossed a bridge. When the toad—inevitably with a name, “Teddy”—was liberated 70 minutes before midnight, it “blinked at the arc lights as though sensing direction, then turned deliberately around and headed for home.” After it had gone around the first corner, it headed “in a straight air line direction toward Wakefield.”

We are informed that at exactly 6:15 the next afternoon, as the author was playing the hose in his garden, “a dusty looking toad, with a small tag hitched to his hind leg, came hopping down the driveway. He hopped under the faucet and cooled himself with the drippings. I examined the tag. Sure enough it was Teddy.”

The manner in which this story is told—the details of the time of

liberation and the hour of return, the care taken to make identification certain by tying a tag to the leg—lend authenticity to the anecdote. But let us consider some additional facts. Automobiles kill thousands of toads annually, but aside from such dangers in a city filled with motor vehicles, there were storm drains, rivers, and other hazards that the toad must have encountered. Such amphibians often fall into man-made pits and become trapped. Moreover, toads are primarily nocturnal, and unless the air is saturated, their moist skins constantly lose water. Consequently, they are unable to venture far from retreats in the damp earth except on rainy nights. It is exceptional to see them active during the day. Yet when this Boston toad reputedly reached its old hopping ground late in the afternoon, it was “dusty looking.”

On the basis of such questionable anecdotal evidence, are we to believe that toads can return from points ten miles distant and travel at an average speed somewhat faster than a mile every two hours? And if they can return to home

sites, how do they manage to select the route? It would be gratuitous to assume that they blink at the arc lights and sense their direction. One might as readily assume that toads carry a compass in the hip pocket.

There is a popular tendency to imagine that animals are guided by some mysterious sixth sense. Animals living on land generally utilize the same senses that man does—sight, smell, hearing, and touch. The reliance they place on any one sense differs, of course, but scientific tests usually dispel any mystery. With the possible exception of some birds that are able to make long migrations without having covered the route before and without older birds to guide them, there is little reason to suppose that creatures of the wild use cues different from those employed by man.

The early naturalists noted that during the breeding season frogs and toads congregated around breeding sites. Some of them obviously had come a few hundred yards to do so. And in Panama, Dr. C. M. Breder found that a male tree frog returned night after night

# Homing Toad Comes Home"

Before accepting newspaper reports of record journeys, it is well to know what scientists have learned about the toad's direction-finding equipment and the things that cause him to move at all

By CHARLES M. BOGERT

*Chairman and Curator,  
Department of Amphibians and Reptiles,  
American Museum of Natural History*



▲ THE PLAZA and buildings of the Archbold Biological Station in Florida—the base from which the homing experiments were conducted. A fair number of toads released a mile distant in unfamiliar territory managed to return to the plaza

to the peculiar mud basin it had constructed, to care for the eggs its mate had laid. Dr. W. L. McAtee tells how a man sought to remove a bullfrog that he suspected was responsible for the disappearance of ducklings on his lake. The frog was carried to a small, isolated spring a quarter of a mile away. A few days later, a commotion involving a duckling on the lake disclosed the reappearance of the vanished bullfrog.

Around the turn of the century, Dr. Robert M. Yerkes showed that the green frog could find its way through a simple maze, although it was slower in doing so than the reptiles, birds, and mammals that had been tested. Once a route was learned, the frog could remember it reasonably well for at least one month. At first there was a strip of red cardboard at the right side of the entrance and white cardboard at the left. After the frog had learned the maze, Dr. Yerkes reversed the colors. The frog was evidently confused, indicating that vision as well as the complex sensations of turning were involved in the learning process. Other evidence showed

that the frog could recognize the presence of wires on the floor of the maze, and hence touch also may have been used.

Frogs can hear, as almost everyone has noticed; when one frog starts croaking, he is likely to be joined by a chorus. An estimate of their hearing ability has been gained by gradually bringing spade-foot toads toward a breeding site where others of the same species were calling. When within 600 yards of the chorus, the captive toads, both males and females, became excited and active. There is no indication that the hearing of toads is more acute than man's, but apparently they distinguish between, and are attracted by, the calls of their own species, even though to the human ear the mixed chorus is little more than a din. Only the adults respond however; juveniles ignore the calls of adults.

It is apparent, therefore, that vision, hearing, touch, perception of its own movements, and memory are all present in the toad. Under natural conditions various landmarks, rocks, plants, depressions, or hills may become significant to

the animal. In its home territory the presence underfoot of sand, pebbles, or grass may have meaning in terms of location.

This, in turn, brings up the question of what constitutes "home territory." Dr. Edward Raney found that some bullfrogs in upper New York State move less than 100 feet throughout the summer, and none that he studied moved more than 100 yards. But frogs seem less inclined to wander than toads. Dr. A. P. Blair reports that one American toad traveled as far as 900 yards in 10 days, although it might have been carried by floodwaters. Toads may travel even farther, for Dr. Ray Nichols followed the movements of a number of Fowler's toads and found one individual that had of its own accord traveled 1400 yards.

This might mean that an occasional toad might be familiar with an area extending almost a mile in all directions, but the territory actually frequented by an animal is likely to be highly irregular in shape and not necessarily round. Let us see what bearing these facts have on any attempt to analyze how far

a toad may travel to "come home."

To carry out homing experiments, Dr. Raymond B. Cowles, of the University of California, joined me in Florida. Thanks to Mr. Richard Archbold, we had the facilities of the Archbold Biological Station at our disposal. Here in the middle of the Florida peninsula, at the south end of the Highlands Ridge, over a dozen kinds of amphibians were present, most of them right at the door of the living quarters. Because the large size of the Carolina toad made it conspicuous and easy to capture, we chose it for our work. The abundant rainfall and the nature of the landscape, with a strip of cleared land adjacent to a wooded area, proved to be ideal. To the east of a large paved plaza there was a gradual rise topped by Red Hill, 222 feet above sea level, a notable elevation in Florida. This area was covered with scrub pine, palmetto, and other shrubs, relatively undisturbed except for a drainage ditch and an occasional lane cleared to restrict the spread of possible fires. The Carolina toad was abundant in and around the clearings, especially in the vicinity of a small truck garden.

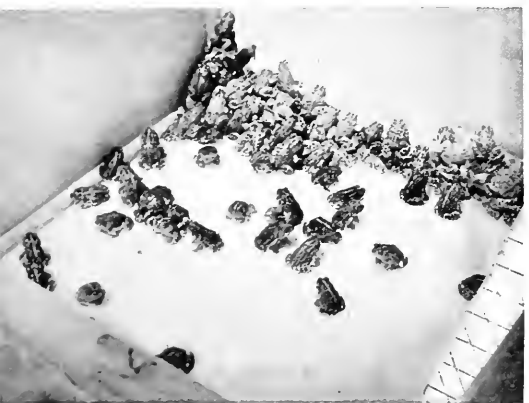
To the west there was a virtually flat area from which nearly all timber had been removed, and the remaining grass and palmetto were

burned annually. This vast open space drained toward the Station, however, and after heavy rains large ponds a foot or so in depth accumulated a few yards from our quarters. At least ten different kinds of frogs and toads were breeding here, many of them calling simultaneously. Although some called early in the evening and others did not start until later, there was a considerable overlap. The Carolina toad first laid eggs in a shallow drainage ditch that flowed northward, carrying the runoff to Lake Annie a mile away. However, the ditch was abandoned in favor of the natural ponds as soon as the rains had filled them. Except for these marginal pools, the cleared area evidently was an unsuitable habitat for the Carolina toad. Whether because of the lack of shade and cover or because of the annual fires in the area, we never found a single Carolina toad west of the pools. This was important to note, since it implied that the area was "unfamiliar territory" to the toads found around the plaza.

We decided at the outset that in our experiments we would use only toads that could be taken in the immediate vicinity of the buildings and the plaza. For the purposes of our study this was considered the toads' base of opera-

tions. Any toads that had been removed and subsequently were found in the plaza were presumed to have come "home." Actually we had pretty good evidence that each toad normally stayed within an extremely limited portion of this home area. One individual, readily identified because it had two toes coalesced on its right hind foot, appeared at the corner of a shed one night. Because we were no longer trying to capture toads, we merely examined it to ascertain whether it was a marked individual that had returned. Since it wasn't, we tossed it a few feet away into a palmetto. During thirteen of the next fifteen nights that we looked for it, we found the identical toad sitting within two feet of the place where it had originally been found, quite undiscouraged by its toss into the scrub.

Our work was started in May, with the advent of the summer rainy season. When there was only a light shower, few toads appeared around the plaza at night. After a heavy rain, toads could be found in quantities—the more rain the more toads. These were gathered nightly until there was a sufficiently large assemblage to start our experiment. Each toad was given a special number that identified it. One lot was taken 450 yards to



READY FOR THE TEST: toads captured around the paved plaza (right) and marked for later identification. To about 800 toads, an area only 70 by 100 yards was apparently home





the east and released in the dense scrub. A few days later, two other lots of marked toads were carried 100 and 300 yards, respectively, to the burned-over area west of the Station—territory that the species ordinarily shunned. As the necessary toads were captured, one lot was taken 850 yards downhill to the north and released on the road between the cleared area and the burned area. Another was then released 750 yards from the plaza—the second to be liberated in the dense growth to the east. Finally, some 43 toads (nearly one-fourth of the 200 marked and liberated) were placed in a sack, as all others had been while being transported, and carried one mile to the west.

A lot of hopping over rough terrain would be required if these toads were ever to see their home territory again. The land was relatively flat and denuded of most of the larger plants. Nevertheless, there remained small patches of palmetto, clumps of grass, hillocks, pools, puddles, limbs, and decaying trunks left by logging operations of the past.

Would any of these toads be able to negotiate the 1760 yards that separated them from their old hopping ground? We felt dubious as we headed for the Station. Perhaps it was little more than a mean trick that we had perpetrated on some helpless toads. Still, we had already found a few that managed to return from the point of release 850 yards away. If there were a sufficient number of rainy nights during the ensuing weeks, we thought that at least some of our amphibian collaborators might make the trip.

At this stage in our experiment we had to return to duties elsewhere, and we could not resume our nightly search of the Archbold Station plaza until two months later. There was a storm the afternoon we arrived, and with rain almost every day, toads began to show up in the plaza, including a few from each lot that we had released at distances varying from 100 yards to a mile away. On the thirteenth night after our return, there was a terrific thunderstorm



▲ A FOCAL POINT for breeding activities: a pool in "home territory" which resounded with the calls of nearly a dozen kinds of toads. The breeding chorus of the Carolina toads proved of considerable significance in interpreting the results of the homing tests

that brought well over two inches of rain late in the afternoon. Frogs, tree toads, narrow-mouthed toads, the noisy little oak toad, and the Carolina toad emerged in hordes. Many of them headed for the pools west of the Station and started calling even before darkness descended. The stentorian voices of the Carolina and oak toads resounded as we had never heard them before.

Strapping on five-celled headlights, we hastened to the edge of the plaza. Between the truck garden and the breeding pools the road was alive with toads, most of them heading westward. Without stopping to look for marks of identification we began picking them up and dropping them into sacks. In an hour's time we secured enough toads to cover the bottom of the large wooden sink in the laboratory. We ceased work only because the toads we had failed to capture were already joining the chorus beyond the limits of the area we had restricted as the "home site."

We tabulated our catch, which

totaled 196, and found that about one-tenth of them were old acquaintances we had marked nearly two and one-half months previously. Moreover, several of these had returned from the point of release a mile to the west. At the end of the month after we had resumed collecting we tabulated our results, and this is what we found: Of 200 toads released at the various distances in three cardinal directions, more than one-fourth, or 53, had returned to the home site.

At first glance the figures showed what we had expected—the farther away individual lots had been carried, the smaller was the percentage of toads that managed to return. About half the toads released at distances of 100 and 300 yards were found again in the plaza. Of those liberated 450 yards away we recovered little more than one-third, and proportionately fewer had come up from the point of release 850 yards to the north.

Studying the results more carefully, an additional fact at first

seemed inexplicable. About 20 per cent of the toads released 750 yards to the east in the wooded area turned up again at the home site. But nearly the same percentage had returned from the point of liberation a mile to the west, in the cleared area that was ordinarily uninhabited by the Carolina toad. We realized, of course, that there was little likelihood that we would find every toad that returned to the home territory. Nevertheless, the odds were in favor of our finding approximately the same proportion of each lot of toads that did manage to find their way "home." If only one-fifth of the toads released less than half a mile to the east were recaptured in the plaza, how could nearly the same

proportion be able to cover twice the distance to return from the cleared area?

As we tried to answer that question we recalled the racket that emanated from the breeding pools on rainy nights. It could be heard far out across the open flats, but when we walked eastward to climb Red Hill the noise diminished rapidly. Sound is absorbed or deflected by trees and shrubs, whereas it carries much farther across open land. Could it be that our marked amphibians responded to the calls of their fellows and were thereby guided to the pools adjacent to the home site?

We looked for additional evidence. Dr. W. J. Hamilton had carried nine juvenile toads four

miles from their home swamp, and a year later found four of them, apparently about a year old, within a few rods of the point of release. This was suggestive. Since young toads do not respond to mating calls, they would not have been attracted by calls from their home swamp. Or perhaps the home chorus was not audible at a distance of four miles. Toads taken from Florida to New Jersey were liberated in a truck garden where some remained for at least a month. Obviously there were a few that made no effort to leave the garden.

The toads we had taken a mile to the west must have been in unfamiliar territory, because the species obviously avoided this open terrain. If landmarks are utilized in selecting a route, the toads carried only 750 yards to the east should have had the advantage of being in territory with which they might have been acquainted. Certainly the "landmark" theory didn't fit the facts, and there was no evidence that it mattered whether the toads were forced to travel uphill or downhill in selecting their route. The sensory cues that permit a toad to learn its way through a maze may very well enable it repeatedly to seek the same feeding site, but they do not serve to explain the toad's ability to orient itself at a distance of a mile in unfamiliar territory.

Considering all the facts at our disposal, we were forced to conclude that the "mystery" of the toad's homing behavior was little more than its response to a mating call. Shakespeare knew a thing or two about biology when he wrote "journeys end in lovers meeting." It has become recognized that the migrations of birds, mammals, and fishes are, in some fashion, always keyed to the cycles of reproduction or feeding, frequently to both.

As for the toad that traveled ten miles to cross Boston, averaging more than a mile every two hours—the author of the "Jumping Frog of Calaveras County" might have made a first-class yarn of the alleged journey. But Mark Twain wouldn't have insisted that you believe it.

## NEVER AGAIN

BY WILMON MENARD

I HAD many hair-raising experiences while goggle-fishing in the lagoon of Nukuraa, one of the low coral atolls of the Dangerous, or Tuamotu, Islands in the far South Pacific, but spearing octopuses underwater was decidedly my most loathsome undertaking. I shall never forget the time I came upon one ensconced in a coral crevice at the bottom of a submerged ledge.

I imprudently launched my spear into the gray writhing bulk and made a perfect strike. But, as the octopus is a boneless, soft creature, I was seized with acute revulsion a moment later when this Gorgon of marine life began crawling in convulsive spasms down my spear point and along my shaft, enlarging the hole pierced through its revolting body. It plastered hideous sucking tentacles around my arms, neck, and chest. Luckily for me, it was not a large octopus. I floundered desperately for the surface, blinded by the sepia it was discharging and shivering from its awful embrace.

Amo, my Tuamotuan tutor, in the canoe, reached down and peeled the damnable creature from my shoulders, exclaiming impatiently: "Aue! Oh my! If this bigger *fe'e*, it pull you and spear into hole. Maybee you no care to live no more, huh?"

I carried for many days thereafter the red kisses of the little demon's tentacles around my chest and arms.



◀ A GREAT SPANGLED FRITILLARY, *Argynnis cybele*, clinging to a spiderwort plant

▼ THE CATERPILLAR of the Great Spangled Fritillary that feeds on nothing but violet leaves. The eggs of this butterfly are laid on or close to such plants so the small larvae will have ample food



# Butterfly BOTANIST

By EDWIN WAY TEALE

Photographs by the author

This amateur with a passion for

violets needs neither knowledge of Latin nor a botany handbook

THE Great Spangled Fritillary, *Argynnis cybele*, is an insect botanist. Without having to memorize keys or count sepals or study an herbarium, it is able unerringly to pick out one group of plants—the violets—from among all the thousands of other species that grow around them. The caterpillars of these butterflies feed only on violet leaves, so the eggs must be laid on or near these plants.

The female fritillary is a botanist by instinct. Using her antennae, she smells her way to the right plants. Even violets that are withered and dry are recognized by the fritillary. In parts of California, where violet plants dry up in July, the females of this same genus scatter their eggs close by, even though the leaves are brown and the plants apparently dead. A single Great Spangled

Fritillary may lay as many as 200 ribbed, honey-colored eggs. From them, after a lapse of from twelve to twenty-four days, come minute, olive-hued larvae. They eat part or all of the shell of the egg from which they hatched and then seek some hiding place, where they survive the hardships of the winter nourished by their single meal.

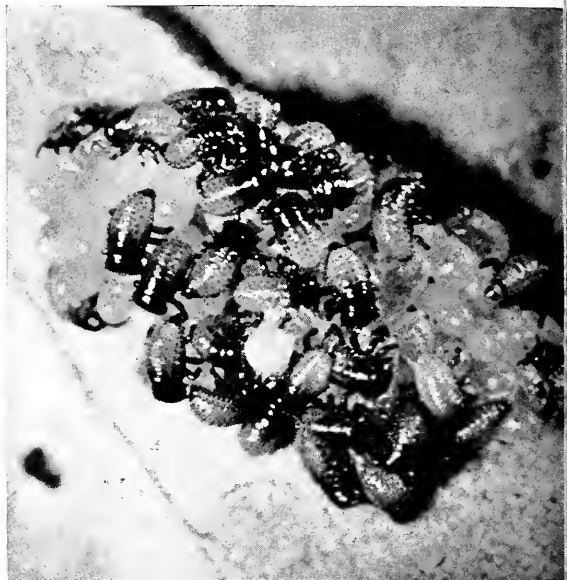
When spring brings tender new violet leaves, the caterpillars appear once more. Hiding by day and feeding during the hours of darkness, they grow rapidly until they are velvety-black larvae an inch and three-quarters long, with black spines based with orange. Then they seek some hiding place under a stick or stone and transform into glistening chrysalises, mottled brown in color.

Two or three weeks later, the adult—its underwings decorated with the shining spots of insect silver that give this butterfly its name—emerges from the chrysalis. Children used to call the silver decorations "butterfly money." On these beautifully marked wings, the Great Spangled Fritillary drifts about over open fields in search of its favorite sources of nectar—the thistle, the milkweed, and the ironweed. An interesting fact is recorded by V. B. Wigglesworth, in *The Principles of Insect Physiology*, about one of the butterflies of the *Argynnis* group, to which the Great Spangled Fritillary belongs. It, he reports, will turn aside from other flowers in the field to visit imitation flowers formed of paper if they are colored purple or violet.



▲ THE ORANGE EGGS are laid in clusters on the undersides of potato leaves in the spring. The parent beetles have spent the winter buried in the soil. Eggs can also be found in midsummer, for there are two or more generations each year

➤ AFTER ABOUT A WEEK the eggs hatch



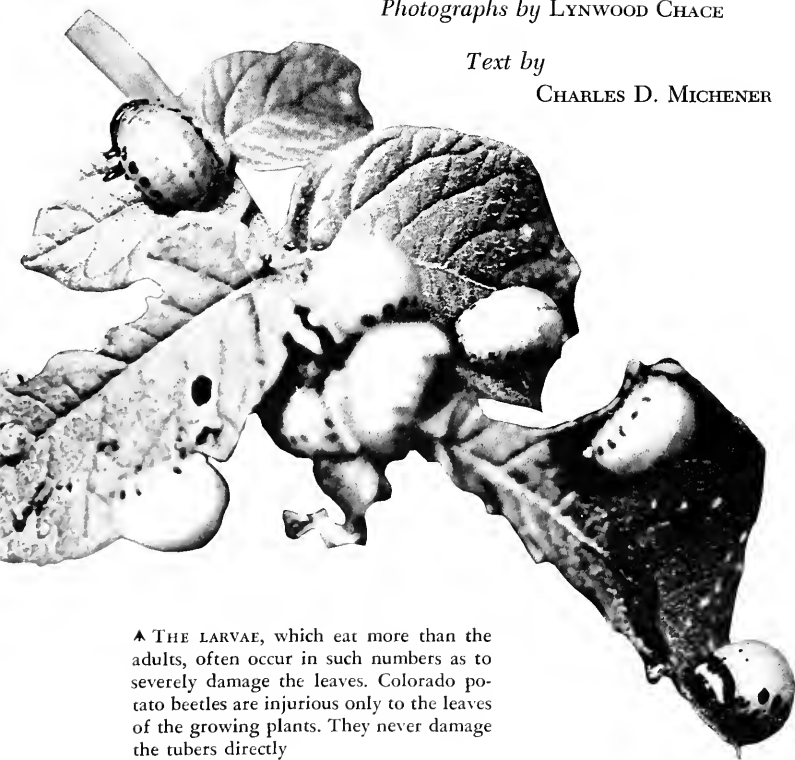
# The Colorado POTATO BEETLE

Photographs by LYNWOOD CHACE

Text by

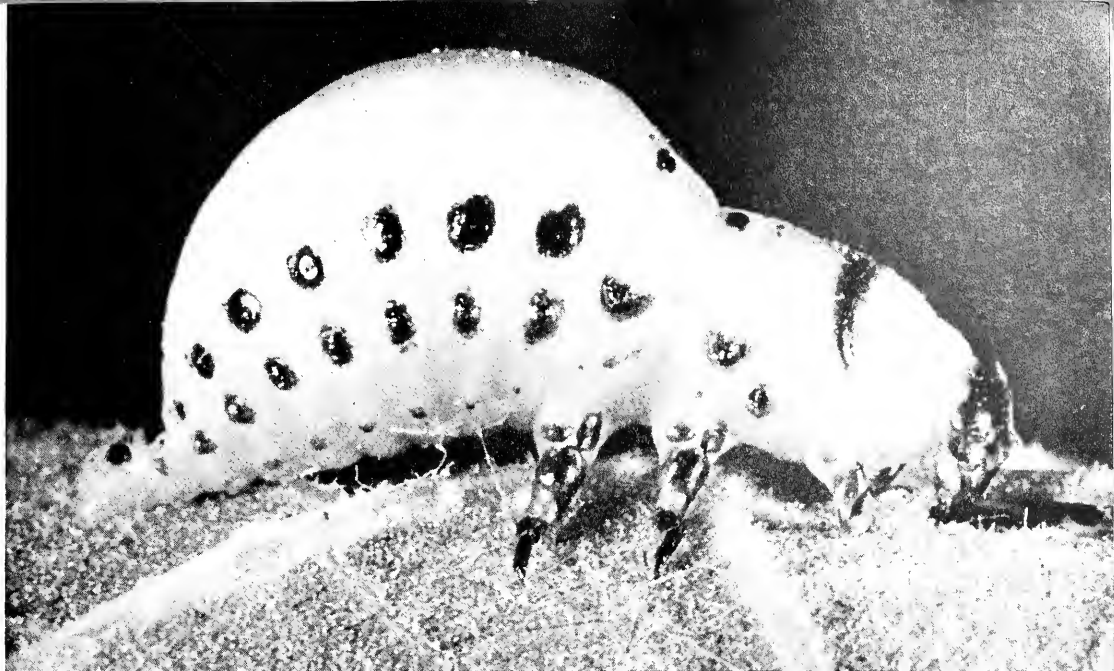
CHARLES D. MICHENER

*Its history  
and life history*



▲ THE LARVAE, which eat more than the adults, often occur in such numbers as to severely damage the leaves. Colorado potato beetles are injurious only to the leaves of the growing plants. They never damage the tubers directly

THE Colorado potato beetle [*Leptinotarsa decimlineata* (Say)] is one of the most famous of our agricultural pests. Unlike most of our worst insect pests, it is a native of this country. It dwelt in the arid lands of the Rocky Mountain region, feeding upon nightshades, especially a spiny species sometimes called sandbur. During the 1850's it became a pest in the potato patches of the settlers in that region and began spreading eastward from potato field to potato field, at first at the rate of about 50 miles a year, later more rapidly so that it reached the Atlantic in 1874. It is now found in all of our potato growing regions except California and is a severe pest also in Europe, where it is still spreading eastward. While it is at its worst as a pest in potato fields, it also attacks tomatoes, tobacco, and other solanaceous plants.



▲ AS THE VORACIOUS LARVAE grow, they become fat, repulsive looking, and orange or red in color with blackish spots. On reaching maturity, two or three weeks after hatching from the eggs, the larvae drop to the ground and pupate in the soil

▼ AFTER THE RESTING or pupal stage the adult beetle works its way up out of the ground. It is yellowish-white with black stripes and spots above; beneath, it is brown. The entire surface is polished and shining. The beetle walks or flies to a potato plant, and unless winter is near, the cycle starts anew



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**N**EAR Sydney, Australia, there is a small nature preserve called Koala Park. It consists essentially of a number of eucalyptus trees and the koalas inhabiting them. Australian friends tell me that the standard reaction to the koalas, whether it comes from an American or a European, is: "Don't they look *just* like teddy bears!"

There can be no doubt about the resemblance, but the comparison works the other way around: the koalas do not look like teddy bears, teddy bears look like koalas. Koalas inhabited the earth—more specifically, Australia—for a minimum of a couple of million years before the first teddy bear was made, and, furthermore, the teddy bear (which was named after Teddy Roosevelt)

was fashioned after a stuffed specimen of a koala. However, the man who first discovered the animal, and the artist who fashioned the world's most universal toy, share the same fate: *their* names are unknown.

Australian scientists, as may be imagined, have generously spent time and effort to trace the story of the most humanly appealing animal of their continent. But so far they have failed to uncover the identity of the person who first saw the koala. All they know is that a young man, who remained anonymous, set out from what was then

the very new settlement at Port Jackson, Australia, and traveled inland. That was in January, 1798. After a journey of some 60 miles, he reached the Blue Mountains, and there he saw koalas sitting in the tall trees.

Port Jackson, near Sydney, was sighted and named by Captain Cook. But it remained unsettled until 1788, when it was founded as a penal colony for English criminals. This fact may or may not account for the preference of the koala's discoverer to remain anonymous; in any event, he probably

## The Two-Thumbbed "TEDDY BEAR"

Was it poison that was killing the koala—that appealing little animal that might have just stepped out of a Disney cartoon? Botanical science unraveled the clues

By WILLY LEY

◀It was a stuffed koala that gave the idea for the teddy bear, named after Teddy Roosevelt

had some measure of education, because he stated that the animal "much resembles the sloths in America." He also reported that the natives called it *cullawine*, a rather poor rendering of the name.

Since the koala, like the South American sloth, spends the major portion of its life span (about fifteen years) in treetops, the comparison was to some extent justified. And for a short while the name stuck. A now very rare book, Perry's *Arcana*, published in 1810, calls it "Koala or New Holland Sloth." A few years later, the French zoologist H. M. de Blainville came up with a scientific name for the new discovery. He called the animal *Phascolarctos*. This imposing name is compounded from two Greek



Photo courtesy Australian News and Information Bureau





Photo from Three Lions

▲ THE YOUNG KOALA clings to its mother's back and frequently returns to this position even after it can forage for itself

words which mean "bear" and "pouch." The German zoologist Goldfuss added the second part of the scientific name, *cinereus*. So the full name, when translated, reads "ash-colored pouched bear."

The scientific name eliminated the label "New Holland sloth" or "Australian sloth," by which the animal had been known in Europe. The Australian settlers had never used it themselves; they followed plain resemblance and named their strange, arboreal marsupial the "native bear." A small boy of the present generation of Australians went them one better by calling the koala the "baby-faced bear." But now Australians mostly use the native name "koala," even though nobody is quite sure what it means.

Some experts believe it means "does not drink." It may, and it would be appropriate if it did.

Literally, the koala never drinks. When it does, the zookeeper knows that he has a moribund koala on his hands. Every specimen that has been seen to drink water has been found dead a few days later. Also, the koala does not perspire. If hot, it will lick its dense and woolly fur, and presumably it gets some cooling effect from the evaporation of the moisture. Because it does not sweat, the koala always gives the impression of extreme cleanliness; it never produces an odor but smells sweetly, if sometimes strongly, of eucalyptus oil.

The koala also has no lice or other external parasites. The South American sloth, on the other hand, harbors algae in its similarly thick and dense fur and also moth larvae, which eat these algae. In fact, all three genera of South American sloths have their distinct variety of fur moths.

But the koala does suffer from ticks, as does everyone who makes its acquaintance, and it is not free from intestinal parasites. At least three different kinds of tapeworms have been identified. The koala subsists exclusively on eucalyptus leaves (with some young bark throw in). Its intestinal apparatus is rather large, for Nature, appar-



Photo courtesy Australian News and Information Bureau

▲ THEIR HAND is not cleft between the thumb and the other fingers but between the index finger and the middle finger, giving it "two thumbs"

ently finding that the normal intestinal tract cannot handle the difficult job of extracting enough nourishment from leaves, has equipped the koala with the biggest vermiform appendix of the animal kingdom, which measures as much as eight feet in length. This constitutes a secondary digestive tract.

When looking at photographs of the koala (only Australians can watch the real animal in the open), one is first impressed by the comparatively large head and the big, hairy ears, not to mention the large nose, which looks as if it were made of black rubber. The koala seems to wear a permanent expression of mild surprise, relieved occasionally by something like hurt dignity or absent-minded concentration. But once you tear your eyes away from its comical face and large head (the skull of a 30-inch koala is  $5\frac{1}{2}$  inches long), the strange shape of its hands and feet become apparent.

The koala's foot can be compared to a human hand or, better still, to the hand of the big apes. The four toes are of fairly equal length (with the "ring finger" the longest), and they bear long, sharp claws. The "big toe," like the thumb

of an ape, is set "far part" and does not even have a nail. The hand has five fingers of about equal length (again the "ring finger" is longest), and all have long, sharp claws. But the hand is cleft not between the thumb and the other fingers but between the index finger and middle finger. The koala has the equivalent of two thumbs, an arrangement that enables it to hold tightly to its tree branches. It is a slow and careful climber and prefers to sit down in a fork whenever possible. For a koala to slip and fall out of a tree is a great rarity. On the ground the animal looks clumsier than it actually is. Though it spends most of its life in the tree, it sometimes has to migrate from one tree to another at ground level.

To human eyes a male koala looks very much like a female koala, or, as zoologists put it, "the secondary sex characteristics are inconspicuous." But the koalas themselves don't make mistakes. Each male has a small but jealously guarded harem. Young males that have reached adulthood are pushed out of the family, often bodily—although sometimes the old male will

lose out. In any event, the lonely male will sit down somewhere and start braying—at least so it sounds to human ears. But to female koala ears this is a siren song that is absolutely irresistible, and thus the outcast male collects a small harem for himself.

As is the case in all pouched mammals, or marsupials, the koala is born in a semifoetal condition. Though the adult reaches a weight of 30 pounds, the young koala is smaller than a newborn mouse at birth and must remain in the pouch for several months. Then the young koala is transferred to its mother's back, where it is carried about for almost a year. Even when the young koala is able to climb around by itself, it will still return to the mother's back, especially for feeding. The koala lacks a kneecap or patella. But since, like man, it is supplied with a clavicle or collar bone, the mother is able to reach behind her and pass branches to the young on her back. The same ability to move the arms freely enables the mother koala to spank her young.

One young koala, kept in captivity with his mother, had the habit of climbing out to the very end of thin branches, where the mother could not follow. The keepers could see that she was worried, and they wondered what she would do. At the very first opportunity, mother koala grabbed her offspring and spanked him on the part that is also the popular target of human parents. The young koala wailed and yelled so that passing cars stopped, and the drivers stepped out to see what was going on. But neither the wailing nor the audience influenced the mother; she continued to thrash the young one until she found the punishment sufficient. It is said that the young koala was intelligent enough to realize what had caused the punishment and did not climb out on thin branches anymore.

Only one offspring is usually born at a time, and because its care occupies the mother for so long, the koala is slow to reproduce—as a rule, every second year. Even with this slow rate of reproduction,

the number of koalas that once inhabited most of eastern Australia must have been enormous.

The koala's pelt is warm, durable, and rather beautiful; and for many years the animal was hunted for its fur. Otherwise it had no commercial value. It is stated that the natives ate koala and liked the meat, but the few whites who have tried it deliver highly contradictory reports. One of them said it was good and reminded him of the meat of real bears which he had hunted in Russia; others stated that it was abominable, smelled of eucalyptus oil, and would be eaten only by a starving man.

But there was no disagreement on the value of the pelt. In the past, koala pelts were shipped from Australia by the hundreds of thousands, and as late as 1920-21, 205,679 koalas were killed. This slaughter is now over, as a law has fortunately been enacted to protect the animal from extinction. No doubt the fate of the American bison was cited in the proceedings. But just as American scientists worried about the survival of the bison even after the necessary laws were passed, the Australian scientists re-

mained anxious about the koala, for he seemed a delicate animal. The main mystery was solved some years ago, mainly owing to one man, Ambrose Pratt, the President of the Royal Zoological Society of Victoria; but there is still cause for anxiety.

The mystery was this: koalas that were kept in zoological gardens invariably died. And they died suddenly. It seemed as if the disease that attacked them progressed beyond help before the first symptoms began to show. The maximum life span of a koala in a zoological garden was recorded as four years; fifteen years would have been normal. In one instance, fourteen koalas died within a period of one year after their admission to the zoo. Three others that had escaped earlier and were found to have made their home in an old tree near by were left there under observation. They stayed in the tree for a full three years; then they were recaptured and put back into their enclosure. They died within nine months, apparently of indigestion.

Ambrose Pratt, who witnessed the tragedy, was desperate, but

certain minor facts had already put the germ of an idea into his head. Naturally every dead koala had been dissected to determine the nature of the disease that had killed it. In all cases the result was negative. Since the death had always been sudden and with almost no warning, Pratt thought of poison—not deliberate poisoning, of course, but some natural poisoning. The problem of keeping koalas alive had naturally been approached as a medical question. What if it were a chemical problem instead?

Pratt had seen a clue in that three-year stay of the escaped koalas in a near-by tree. While captive, these koalas had been fed select, fresh branches of eucalyptus. Escaped, they retired to an old tree and happily chewed its tough, old leaves. Recaptured, they died. Of course, even koalas in freedom did not always eat old leaves. But might not the whole performance be an indication that there was something chemically wrong with young leaves, at least temporarily or perhaps periodically?

First it should be explained that the koala does not feed on *any* eucalyptus tree. Eucalyptus trees



Hiendreaux photo



Ewing Galloway photo

▲ AN EXPRESSION of mild surprise mingled with hurt dignity

➤ KOALAS never drink, never perspire, smell sweetly of eucalyptus

THE TWO-THUMBED "TEDDY BEAR"



International News photo

▲ SMALLER THAN a new-born mouse at birth, the young remain in the pouch several months, then rides pick-a-back for almost year

(Australians call them gum trees) are a large family of over 200 varieties. More enthusiastic botanists even distinguish over 500 varieties. The koala eats the leaves of about five but prefers one or two specific kinds, which, however, are not the same ones everywhere. The favorite eucalyptus of the northern koala is not the same as that of the southern koala. (The latter, incidentally, is a much larger animal, although all koalas belong to the same species.)

In addition to the numerous varieties, each eucalyptus produces two kinds of leaves. For a short period when young, it has leaves that look very different from the normal leaves. These are called "juvenile leaves." Even if the tree is not young, if it is badly injured by accident or fire, the new shoots springing up will bear "juvenile leaves." Although not a botanist himself, Ambrose Pratt knew these facts. What he did not know was that some plants, under certain circumstances, produce hydrocyanic

or prussic, acid. One of the botanists with whom he conferred, P. R. H. St. John, knew definitely that one kind of eucalyptus could produce prussic acid. And he remembered having read somewhere that one of the favorite food trees of the koala did, too. The search was on. Once the investigators knew what to look for they found numerous references stating that this or that variety of eucalyptus had been found to produce prussic acid. This was particularly the case with trees whose leaves had been macerated or frozen.

But all this seemed to apply mostly to the so-called "sugar gum" (*Eucalyptus cladocalyx*) and not to the "manna gum" (*E. viminalis*), the koala's favorite. Just at that point three chemists, who were totally unaware of the uproar in zoological circles, published a paper on the prussic acid-producing compounds in Australian plants. They calmly stated that the "manna gum" could produce the poison, too. And, more important, they added that the amount of these compounds was largest in juvenile leaves and generally in young leaves of young trees. Those of the sugar gum contained enough prussic acid in less than one ounce of leaves to kill a sheep!

This, of course, taught the zoologists a big lesson: no juvenile leaves for the koala and no young leaves from young trees without simultaneously providing a choice of old leaves. The koala, if given a choice, always avoids toxic leaves, even though they look fresh and harmless to its keeper. The large nose of the koala may be the warning instrument, but even in freedom, after a bush fire, the koala is sometimes forced to disregard the warning. Then "mysterious" mass deaths of koalas occur.

Unfortunately, the discovery of prussic acid in eucalyptus leaves did not solve the whole problem. There seems to be a second plant poison which varies in strength with the seasons and which the koala sometimes tolerates and sometimes doesn't. Possibly the koala's tolerance varies with the seasons. Suspicion centers around a sub-

stance called cineol. Chemists know its formula— $C_{10}H_{18}O$ —and physiologists know that it lowers the body temperature. And there is another substance called phellandrine, with the formula  $C_{10}H_{16}$ , which does not have as pronounced a physiological action but seems to raise the body temperature. Both of these substances are contained in the essential oil of eucalyptus leaves. The amount varies with the variety of tree and probably also with the climate.

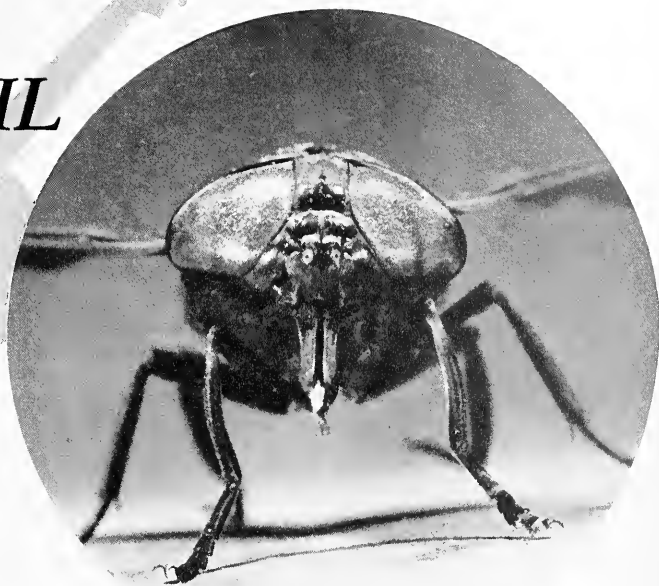
The survival of the koala in zoological gardens therefore developed into a problem of providing a choice of food trees, preferably old ones. Once this was known, the remedy was comparatively simple. Instead of tight little enclosures, large open enclosures with old trees growing in them were provided.

Regarding the ultimate survival of the koala in nature, literature is full of contradictory reports. Many Australian scientists are inclined to view the situation with alarm. But C. A. M. Reid, who was in charge of the Australian fauna display at the Golden Gate International Exposition at San Francisco in 1939, stated that "the koala may be dying out in New South Wales, but in Queensland, which is its hope, there are easily 800,000 of them in the bush, and each year they are coming back to areas they had deserted."

The koala was excluded from the San Francisco Exposition, because it was considered impossible to provide eucalyptus leaves for it. But in California, Mr. Reid discovered to his surprise that six different varieties of eucalyptus could have been procured, within easy reach of the Exposition. So the koala could be introduced into California. This, on first thought, seems like an appealing idea. It would be nice to give the two-thumbed teddy bear as large a range as possible. But even though the koala doesn't reproduce rapidly, and there is a limit to the number of eucalyptus trees, we would do well to remember the rabbits which, when introduced into Australia, became dreadful pests.

# Meet the BLUE TAIL FLY

Some interesting clues lead to the identity of the insect in one of Abraham Lincoln's favorite songs



By C. H. CURRAN

Curator, Department of Insects and Spiders,  
American Museum of Natural History

*De debble take dat blue tail fly.*

This single line from a currently popular song puzzled me since I first heard the lively tune. My knowledge of music is of such a low order that I cannot tell one note from another and don't always know whether a singer is on key. But I do know when I like a song, and I immediately liked the lilt of "The Blue Tail Fly." Its revealing first verse was captivating:

*When I was young I us'd to wait  
On Massa and hand him de  
plate;*

*Pass down de bottle when he git  
dry,*

*And bresh away de blue tail fly.*

I also had a hunch that sooner or later these verses would cause me some embarrassment. It was not long before they did. My wife asked me to tell her the proper name of the blue tail fly. So did quite a number of friends and acquaintances. I said the answer was very simple. There was no such fly. The thing existed only in the imagination of the song writer.

If the tune had not continued to be popular, I should have for-

▲ THE CAMERA reveals in sharp detail the features of the principal character in an ancient and honorable folk song—*Tabanus atratus*

gotten about the insect, but hearing the song several times a week kept me puzzled. Each time I heard it, I tried to visualize the blue tail fly. I knew of flies from Africa, South America, China, Australia, and the East Indies that had "blue tails" or blue tips to the body. However, since none of these were of the biting kind, it seemed apparent that the writer of the song had drawn extensively upon his imagination and that the blue tail fly was just a good character in a snappy ditty.

The first indication that there really was a blue tail fly came one night when a radio announcer stated that a certain singer would sing an old American folk song entitled "Jim Crack Corn." This is another name for the same song, and it rekindled my lingering interest in the identity of the fly. Then, a few days before the anniversary of Lincoln's birth, it was announced that an orchestra would play two of Abraham Lincoln's favorite folk songs. One was "The Blue Tail Fly."

So it seemed obvious that the blue tail fly actually existed, but still I could not satisfy myself as to its identity. Presumably it was a Southern fly. Then the answer came most unexpectedly. I realized that the blue tail fly must have a terrific bite and that it must be common because:

*An' when he ride in de artemoon,  
I foller wid a hickory broom;  
De poney being berry shy,  
When bitten by de blue tail fly.*

Obviously, it must be a horsefly. But it must also have a blue body, and no American horsefly seemed to qualify. Then I remembered that during a biology course many years ago I had caught a specimen of *Tabanus atratus*, the black horsefly, and a student from Georgia had called it the "blue-fly." I went to our horsefly collection, and although most specimens of this species are wholly black in death, there are some that retain a blue sheen on the abdomen. In life most of them have it.

The evidence that this is the blue tail fly is all but conclusive, and it is also evident that the song is Southern in origin. *Tabanus atratus* is found east of the Mississippi, from Canada to Florida. Its abdomen has a bluish sheen in life, and there are many records of its having caused horses to run away. That the fly fits this description perfectly is attested by the following:

*One day he rode aroun' de farm,  
De flies so numerous dey did swarm;*

*One chance' to bite 'im on the thigh,*

*De debble take dat blue tail fly.*

*De poney run, he jump an' pitch,  
An' tumble massa in de ditch;*

*He died, an de jury wonder'd why*

*De verdic' was de blue tail fly.*

Of course, the "master" died from being thrown into the ditch, not directly from the bite of the fly.

*Dey laid 'im under a 'simmon tree,*

*His epitaph am dar to see:*

*Beneath dis stone I'm forced to lie,*

*All by de means ob de blue tail fly.*

The "simmon" is a southern tree whose fruit is strongly astringent until fully ripe.

The origin of many American folk songs is buried in antiquity, and the exact origin of some of them may never be traced. Many of them are adaptations or modifications of folk songs that originated in the Old World. But *Tabanus atratus* is strictly American, and further evidence is provided by the chorus:

*Jim crack corn I don't care,  
Ole Massa gone away.*

Only 100 years ago it was common practice to "crack" corn to the consistency of corn meal in home pestles by the mere process of pounding the grain and removing the coarse husks, which were fed to pigs, cattle, and fowl. So we see that "The Blue Tail Fly" must be strictly American and from Dixie.

show how the weavers of Huaca Prieta worked. Their loom probably consisted of a single stick from which the warps were suspended. In twining, the weft threads are simply twisted about each warp thread, one after another, instead of being shot through between the two banks of separated warps. Therefore, the so-called heddle, which spreads the warps to form a V-shaped passage for the shuttle, was not needed. Nor were any other weaving tools required. None of the twined pieces show any pattern or design, though pleasing effects were created by warp manipulation.

The netted, looped, and coiled constructions, like knitting, are all made by working with a single yarn or cord. Among the looped pieces are a number with openwork, geometrical patterns.

Perhaps the most interesting are the woven pieces. They are all small, the widest perhaps seven or eight inches; they are all warp-faced and are all combined in some way with twining. The twining may be limited to compact twined weft at the warp ends, or in addition to this, there may be twined rows between woven areas. Rarely a single fabric will have adjacent twined and woven areas with the weft yarns crossing both. Simple single- and double-faced patterns were achieved by floating warp yarns. In some, short weft yarns were used with their ends tied in knots along one side selvage, as were the weft of the twined fabrics.

After examining these pieces, it is fairly clear that the weaving was done without benefit of a heddle. Without this simple device I doubt that weaving could compete with twining. If evidence from this obscure site can be used for a generalization, it appears that weaving started long after fabrics were being made by twining; that it was not derived from twining but originated in the experimental manipulation of yarn; and that until someone invented the heddle, weaving was of very minor importance.

So far we have found only one

dye, a blue used to a very limited extent. More common was the practice of rubbing a red pigment on the yarn and finished pieces.

The finished fabrics were not made up into garments, and it is not clear just how they were used. On the dead, they were sometimes draped over the shoulders, sometimes about the hips, but with no consistent arrangement.

Matting made of totora, like the textiles, was almost always of a twined construction. The only exception is matting made by using junco as warp and weaving in a cord weft. In basketry, which was quite common, only the twining technique was used.

Virtually all of our information comes from discarded or lost specimens. Almost nothing was placed with the dead. At first, the bodies were buried in very shallow graves in the mound, with no uniformity of position or orientation, and were covered with garbage. Later on, subterranean vaults and abandoned houses were used, and in these there were sometimes a number of bodies. We saw no evidence of food having been placed with them and, except for gourds, nothing in the way of special equipment. In one instance a little cord pouch lay beside a body, protected by a scrap of old matting. In it were leaves, twigs, and dried flowers. Though most of the tissue had crumbled from the skeleton, in its mouth was a half-chewed wad of the same

Answers to Cryptomaze  
on page 319

H <sub>1</sub>	V <sub>2</sub>	E <sub>3</sub>	B <sub>4</sub>	O <sub>5</sub>
U <sub>6</sub>	C <sub>7</sub>	I <sub>8</sub>	T <sub>9</sub>	P <sub>10</sub>
S <sub>11</sub>	R <sub>12</sub>	O <sub>13</sub>	L <sub>14</sub>	U <sub>15</sub>
T <sub>16</sub>	P <sub>17</sub>	A <sub>18</sub>	N <sub>19</sub>	M <sub>20</sub>
S <sub>21</sub>	E <sub>22</sub>	K <sub>23</sub>	I <sub>24</sub>	G <sub>25</sub>

TREES: Apricot, Birch, Coconut, Larch, Locust, Oak, Olive, Palm, Pear, Plum, Poplar, Spruce, Tea, Teak, Tung



plants. Suspecting that they might be medicinal, I asked the workmen, and the response was immediate: "Oh, yes, señor, that is the *turri*, very good for toothache and the kidneys." Whether these were the properties ascribed to it in bygone days will remain a mystery.

After it became clear that the Huaca Prieta was abandoned prior to the use of ceramics, we sought more midden which might reveal something of the subsequent record. This we luckily found a few hundred yards to the north, where refuse of more or less continuous occupation carried through from the preceramic period into a time when plain, utilitarian pottery was used. Above it lay debris containing the elaborately modeled and incised Cupisnique or Coastal Chavin pottery. This is a long story in itself—far too long to include here.

Ten months to the day after first setting up our tents, we reluctantly broke camp, for within a mile of that spot it would have been possible to complete the archaeological story from the period we had been studying right through into historical times. The ideal conditions of preservation would have permitted a reconstruction of the full development of the local agriculture and a determination of the textile chronology, and would have clarified many obscure details of the material culture.

Our choice of location had been fortunate, for it later proved that the three preceramic mounds near Guañape in the Viru Valley had a high sand and moisture content,

resulting in the loss of most of the perishable material. Two other contemporary mounds north of the Huaca Prieta seem more promising. A comparison of these various sites shows that they had been chosen in part because of the suitability of the locations for net fishing and in part on the availability of land where the proximity of ground water to the surface could have made farming without irrigation possible. The compactness of each community suggests a gregarious tendency on the part of the people. Though we found some traces in this region of an earlier, nomadic hunting group, there was no evidence that the early farmers were related to or had contact with them. In fact, there was no obvious reason for their compact communities other than a natural desire for companionship. When they may first have arrived on this coast is purely a matter of conjecture, for as yet we have no sound basis for a time scale. There are fairly good reasons to believe that the Coastal Chavin ceramics can be guess-dated as appearing not later than 1000 B. C. The still earlier record may perhaps represent a span of 2000 years in itself, which would give a surprisingly early date of perhaps 3000 B. C. as the time when our farmer-fishermen first tilled these valleys. I suggest this most reluctantly, for people tend to forget the implication of a guess date and to later think of it as proven. Even if my guess is too early, it is clear that we have made the acquaintance of the oldest farmers yet found in America.

## LETTERS

*Continued from page 292*

cling tenaciously to old beliefs, especially if they date from childhood, when the statements of elders are accepted without question.

Thus many residents of the Del-Mar-Va Peninsula may well maintain that the "wood bitch" is poisonous despite well-authenticated information to the contrary. Moreover, it is evident that their beliefs are somewhat confused. By "poisonous" the original myth probably referred to the bite. According to some purists, "venomous" should be used to describe animals capable of injecting deleterious substances

into the blood stream, whereas "poisonous" is reserved to describe plants or animals that produce ill effects when eaten. These usages have their merits, although medical dictionaries are unable to make such distinctions. Poisons in the stomach may produce no serious symptoms until they reach the blood stream. On the other hand, some snake venoms can be ingested without injurious results. Enough rattlesnake venom to kill 100 rats if injected into the body has been fed to a single rat with no apparent effect on the animal.

By and large the flesh of reptiles, like that of frogs, is not only edible but quite palatable. One sea turtle in the Pacific



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reputedly cannot always be eaten with impunity, presumably because it occasionally feeds upon some sort of poisonous invertebrate. No scientific investigation has been made, but the substance seemingly has no bad effect upon the turtle, even though it reputedly causes severe symptoms in humans when eaten along with the flesh of the reptile.

However, the "ground puppy" of the Peninsula cannot be a reptile, there being no lizard among the four in the region that has "stripes running crosswise." This description can refer only to one of the tailed amphibians, probably the marbled or banded salamander, *Ambystoma opacum*, one of several amphibians called "lizards" throughout the Northeast. In this section true lizards are so scarce that few people make any distinction between

a four-legged creature with scales and a tail, and a four-legged, tailed amphibian with a moist, glandular skin. Some salamanders have glands in the skin that secrete fluids that may be irritating or even poisonous to mammals. Still it is to be doubted that a dog would be poisoned if fed a "ground puppy" that had been cooked, more especially because cooking destroys many poisons of the sort produced by amphibians. But it is possible that the toxins in the skin of this salamander are not destroyed by heat.

The failure of the ants to eat the flesh of the carcass of the "wood bitch" may be attributed to the fact that bony plates having hard, horny coverings which form the scales are imbedded in the skin of skinks, and these are not easily penetrated by an ant. The soft, moist skin

of the salamander or "ground puppy," on the other hand, would be readily removed from the bones by the mandibles of insects. The fact that the ants left the body of the "wood bitch" intact cannot be attributed to poisons in the body of the reptile.

Red is a conspicuous hue that is very generally associated in animals with distasteful or dangerous qualities. As such it serves as warning coloration—in the coral snake or Gila monster, for examples. But in the case of the skinks it would seem not to be of protective value, although it may play a part in sex recognition or territorial behavior. One adult male may permit juveniles or females of his species to invade his domain, while he regards those with red heads as competitors and will drive them out.

## EXHIBITS AND EXPEDITIONS

### Rare African Collection

A collection of the native arts and crafts of the Turkana tribes, who live in the Lake Rudolf area of Kenya Colony, Africa, has been placed on display at the American Museum of Natural History and will remain on exhibit through the fall.

This is unique in being the first group of ethnological specimens from these people to be brought to the Museum, and many of the objects cannot be seen in any other museum. The collection was made recently by the Morden African Expedition and presented to the Museum by Colonel and Mrs. William J. Morden. It presents a cross section of the many and varied articles made and used by the little-known tribes. The objects were collected in the course of a study of the life and culture of the Turkana and neighboring tribes made by Mr. R. Kepler Lewis, who accompanied Col. and Mrs. Morden as field assistant.

The Morden Expedition was also able to obtain collections of the fascinating beadwork made by the Zulu and related peoples. Native handicrafts shown include a unique Pondo hand mitten, used only for shaking hands at a party, a Zulu witch doctor's medicine horn, a Suk beer cup, double-ended spoons, and the two-legged stools that the natives carry always—even into battle.

### African Expedition Returns

The return of Dr. James L. Clark to the American Museum of Natural History on August 10 marked the successful completion of the Museum's Central African Expedition.

Dr. Clark, who heads the Museum's Department of Preparation and Installation, stated that the full-scale expedition had attained most of its objectives, in-

cluding perhaps the first record motion pictures of remote tribesmen in the geographical heart of the Dark Continent and a significant zoological collection.

Many rare insects were uncovered on the expedition by Dr. Neal A. Weber, Associate Professor of Zoology at Swarthmore College and one of the world's leading experts on the biology of tropical ants and other insects. Dr. Weber's studies are expected to add greatly to man's knowledge of the part played by insects in the transmission of tropical diseases.

Most of the expedition's collections have not yet reached this country, but among those that have are bizarre African stalk-eyed flies and giant four-inch long termite queens. The stalk-eyed fly, belonging to the family Diopsidae, has eyes that are fantastically extended from its head on long periscopes. The expedition was able to make the first abundant collection of these exotic flies. Hundreds of them were netted by Dr. Weber about 200 miles southwest of Nairobi.

The natives throughout certain remote sections of central Africa visited by the expedition are badly disease-ridden, according to Dr. Clark. In some areas leprosy alone had affected approximately five per cent or more of the population.

Special reports will be furnished by the expedition to the National Research Council on environmental conditions in this section of Africa and on the operation of various types of field equipment furnished by the United States Army.

Second in command in the field was Mr. Brayton Wilbur, prominent West Coast businessman and President of the San Francisco Chamber of Commerce, who sponsored the expedition and was accompanied by his son. Mr. Murl Deusing, Curator of Education at the Milwaukee Public Museum and noted pho-

tographer and lecturer, covered the expedition's photographic activities.

Most dangerous incident of the expedition occurred when a huge rhino attacked one of the expedition's trucks. The rhino was finally driven off but not until he had left a large puncture in the truck's metal body.

The most notable change in the interior of Africa during the past two decades, according to Dr. Clark, is in the fact that the big game, such as elephants and rhinos, no longer seem to run in huge herds. Big game was encountered a number of times and actually seems to be fairly plentiful in certain regions, but the huge herds, sometimes numbering in the hundreds, are no longer to be seen except in some of the excellent game preserves and national parks.

The expedition was one of the largest undertaken by the Museum since World War II and covered a wide territory in some of Africa's most remote sections. Using Nairobi as the point of outfitting, it ranged afield into several sections of Kenya Colony and on into Uganda, French Equatorial Africa, and the Congo.

Dr. Clark's field manager was Captain Vivian Ward of Nairobi. Captain Ward, a veteran of many major African expeditions, was in charge of the expedition's native complement and the physical field operations. Captain Ward also served as liaison officer between expedition officials and native chieftains and their tribes.

The expedition's personnel numbered thirty-five on its treks into the interior and employed specially designed mobile equipment, including six large trucks. Other members had returned to the United States previously, while Dr. Clark remained in the field and completed arrangements for shipping the collections.

Dr. Clark is a veteran of twenty-five major American Museum of Natural History expeditions, including four other extensive African safaris. In 1931, as leader of the O'Donnell-Clark Expedition, he explored the fringes of the remote areas penetrated on this year's expedition.



October

# NATURAL HISTORY

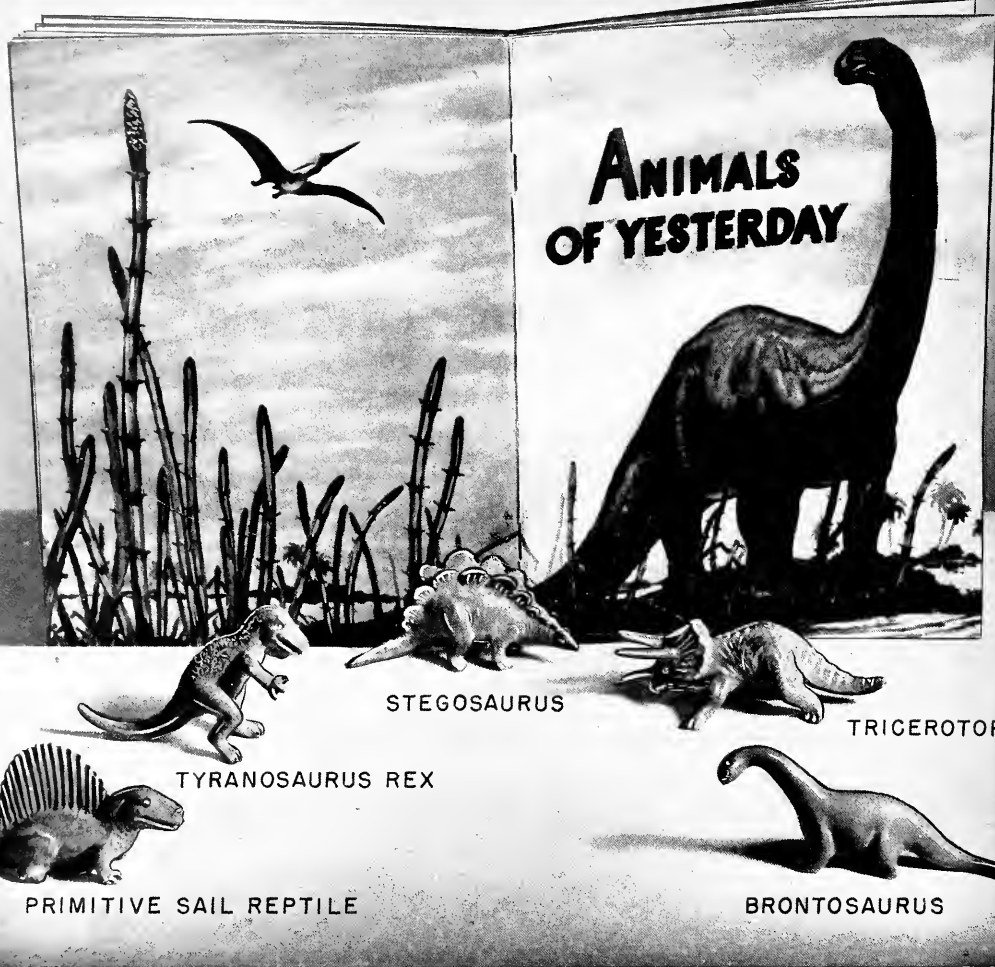
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## *Catfish Tail First*

Sirs:

One fall day when my husband was out hunting, he saw a water moccasin on a creek bank. When he went over to kill it, he saw what appeared to be wings about halfway its length. So after he killed it, he slit it open and found the snake had swallowed a catfish—tail first, and why the fins on the fish had not opened until halfway down in the snake, my husband could not understand. But when the fish *did* lift his fins, they had pierced the skin of the snake and stopped further swallowing.

Can any of you explain how the snake swallowed the fish, tail first, without the fins rising?

MRS. W. EDGAR SMITH.

Baton Rouge, La.

The following comments are offered by C. M. Bogert, Chairman and Curator of the Department of Amphibians and Reptiles at the American Museum:

Ordinarily, of course, snakes simplify matters by selecting the head before they begin the process of engulfing their prey. Projecting spines, fins, scales, wings, or limbs encountered when the prey is swallowed tail first may stop all progress, and sometimes the snake disgorges the morsel and makes a second effort to select the head. However, if the prey is relatively small, the snake sometimes is persistent, continuing its efforts until the animal is drawn into the throat, despite the projecting appendages. Thus the moccasin may have swallowed the catfish even though the spines were locked in position.

There is an alternative and possibly

better explanation. The moccasin sometimes devours dead animals, and if it chanced to engulf a dead catfish tail first the spines may not have been erect at the time it was swallowed. However, as the prey moved tailward the tips of the spines may have become engaged in the lining of the intestinal tract. As the muscular contractions of the snake continued to force the catfish farther back, the spines would then forcibly be raised, piercing the body walls.

Somewhat similar is the ability of an occasional horned toad to kill its predator. Several instances have been reported in the Southwest where snakes have swallowed these spiny lizards, only to suffer death as a consequence. Once the snake has drawn the lizard back into its throat, the horned toad twists the head from side to side, mortally tearing the tissues of the serpent. The Los Angeles Museum has a western glossy snake that was found dead and desiccated near Azusa, California. The "horns" of a Pacific horned toad are projecting from its neck, but the body of the lizard is incompletely engulfed. In other instances reported, the lizard was swallowed before it killed its captor.

## *Some Birds Pollinate Flowers*

Sirs:

I would appreciate your answering this question for me: Do birds assist in the pollination of flowers?

Just outside my window is a large apple tree. For several days when it was filled with blossoms, nearly all fully opened, I watched it closely, looking for bees and wondering whether the cold weather would keep them in until too late for pollination. . . . Then, for half an hour and possibly longer, a pair of Baltimore Orioles appeared on the tree. It was the first time I had seen or heard them this year. They were as busy as bees, thrusting their bills into the flowers and sipping the nectar—at least, so it seemed to me, and at times they were no more than ten feet distant. They were entirely indifferent to insect life. They moved quickly from flower to flower, and their entire interest appeared to be centered on the blossoms. Each visit required only a second or two, and they must have visited many flowers while I watched them.

I wondered if their activities were bringing about pollination. Is that possible with birds? I don't recall ever having read anything about it.

WALTER J. HARMER.

West Newton, Mass.

The following comments are offered by Dr. John T. Zimmer, Curator of the De-

*Continued on page 382*



▲ NATURE PHOTOGRAPHY in the metropolis. Vistas of natural greenery await the enquiring cameraman even in a city park. A photograph taken in Inwood Park, Manhattan, by Fritz W. Neugass



# NATURAL HISTORY

*The Magazine of the American Museum of Natural History*

FREDERICK TRUBEE DAVIDSON, President

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VOLUME LVII—No. 8

OCTOBER, 1948

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## THE COVER THIS MONTH

Bougainvillea brightens the landscape and the people of Guatemala in a way that is truly remarkable. Every dwelling in the uplands, whether it be the miserable adobe shack of the poverty-stricken or the hacienda of the rich, is adorned with this annually flowering bush.

The flower is inseparably bound with the traditions of the many Indian tribes, for its leaves are believed to hold a magic cure for any illness. When sickness threatens, the leaves are prepared as a tea, and the sweet liquor is regarded as an elixir of life.

The pink variety is the one commonly seen, but the darker form also occurs sporadically. When both grow side by side, the effect is truly breath-taking. Bougainvillea is distributed in Guatemala from sea level to about 8000 feet. The plant reproduced on the cover was photographed a mile above sea level near Guatemala City.

ROBERT R. MILLER.

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Atherlie E. Karp, *Editorial Assistant*.

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University of California Press, \$7.50  
284 pp., 41 illu., 8 figs.

AN interesting tendency in the botanical field is the cultivation of a single genus of flowering plants, during which the grower spends many years—frequently the best part of a lifetime—on his specialty. A short time ago I reviewed such a book on lilies. Now we have a similar work on primroses (*Primula*) by a retired professor of chemistry. As he states, "The devotee of the noble art of gardening who is not prepared to enjoy the exhilaration which study of plants from the scientist's point of view gives him, misses a large part of the pleasure which his hobby is capable of yielding." Yet devotion to a single genus of plants is not so limited a field as one might think. To grow several hundred kinds of *Primula*—obtained either as seeds or plant—requires widespread search and correspondence, as well as the study of individual difficulties in soil treatments, fertilizers, drainage preferences, types of lath shelters, diseases, and pests. Similar troubles occur in the growing of any group of difficult plants, so that the author's detailed experience along these lines should be of practical value to any horticulturist.

The larger part of the book deals with species and variations of *Primula*, botanically classified, with something of their individual history, geographic range, and characteristics. In eastern United States, we have only a single species, *Primula farinosa*; in Great Britain there are also *Primula vera* (the "primrose by the river's brim"), the cowslip, and the polyanthus; but the great bulk of species come from western China and the Himalayas. The one map which is included shows the extent of this interesting "Primula Belt" of eastern Asia. This attractive and well-illustrated volume is well worth consideration by every horticulturist. To the scien-

tist not trained in taxonomy it gives a well-presented idea of the vastness and intricacy of just a single genus.

HENRY K. SVENSON.

## THE GROWTH OF PHYSICAL SCIENCE

----- by Sir James Jeans

The University Press, Cambridge,  
England: The Macmillan Co.,  
N. Y., \$4.00  
364 pp., 14 illu.

OF all the great scientists who have written on physical and mathematical subjects in English, Sir James Jeans had the greatest facility in making the most abstruse topics clear, dramatic, and attractive to the layman. One important and significant qualification that he brought to this art was his profound scholarship, for he truly was one of our great physicists, interested especially in mathematics and astronomy. It is immediately evident that he was much more than a scholar, for we have had a number of highly qualified physical scientists who could not make their subject clear and attractive to the layman.

Sir James has written a number of books whose titles have become household words, such as *The Universe Around Us*, *The Mysterious Universe*, *Through Space and Time*, and *The Stars in Their Courses*.

The book now being considered, appeared in America posthumously. It covers a very general field beginning with the early Babylonian method of counting and the earliest Sumerian astronomy and proceeding down the ages to the present days of nuclear physics. The author tells us that he has tried to describe the main

lines of advance of physical science, including astronomy and mathematics, in language nontechnical enough to be understood by readers who have no scientific attainments or knowledge. It seems that Sir James has had this ideal or object in mind with all his books. A host of readers will be grateful that he has given us the present volume, which will give us a more general understanding of how physical science has grown, what it has done, and what it can do.

CLYDE FISHER.

## THE INSECT GUIDE

----- by Ralph B. Swain

Doubleday & Company, Inc., \$3.00  
261 pp., 454 illu.,  
330 plates in color

THE layman who thinks of insects only as "those horrid creatures" may well change his attitude toward them when he reads this book. It is an introduction to the study of insects as well as an excellent insect guide. It describes, briefly and in nontechnical language, what an insect is, the interdependence of insects and plants, insects and other animals, and insects and man. After reading the latter section, the reader may well appreciate the statement that there is an aspect of man's relationship with insects that is distinctly pleasurable—the enjoyment of insects for what they are. Then follows a description of the structure, growth, and development of an insect, accompanied by accurate line drawings. Fortunately for the lay reader, the English names of orders, families, and species of insects are used to facilitate his identification of a specimen.

In the Guide section, the adult and young are described, and the insect's importance and distribution are discussed. The style is clear and interesting. Careful directions are given the amateur on

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how to identify an insect, also how to collect, preserve, and study them. As the author states, "To study insects is to enjoy them. Many are so beautiful in color and form that just contemplating them in a display case . . . gives pleasure. They make excellent subjects for amateur photographers. . . . For most of us the greatest enjoyment comes from observing them out of doors in their natural surroundings." So very little is known about the private lives of most insects that there is much joy to both a professional and amateur when an original discovery is made as a result of persistent, patient observation. How many realize that some of the most remarkable behavior patterns in all of nature are found among insects?

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popular books about insects for young people.

This *Insect Guide* will be a worthwhile addition to the field guides of students and of teachers as well as of the layman. It is indeed a rare pleasure to find a new guide book on insects that can be recommended without reservations to general readers, young and old. Such a book is *The Insect Guide* by Ralph B. Swain and SuZan N. Swain.  
GRACE FISHER RAMSEY.

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- - - - - by Herbert C. Lanks  
Appleton-Century-Crofts, Inc., \$5.00  
66 pp., 48 illusts.

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HARRY L. SHAPIRO.

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## The LUNGFISH, the DODO, and the UNICORN

by **WILLY LEY**

author of *Rockets and Space Travel*

THE VIKING PRESS, New York

flowers are arranged according to their colors. The author calls attention to the plea for just such a book made by John Burroughs many years ago in his outdoor book, *Riverby*. Mrs. Hausman's book is an excellent example of *multum in parvo*. Although it is small enough to slip into one's side coat pocket, it treats of 1080 species of flowers found east of the Mississippi. Naturally it will be found useful westward as far as the Rocky Mountains.

A detailed drawing of the leaf and stem is devoted to each flower, and there is a description giving common and scientific names, color, size, period of bloom, the locality where it is usually found, geographic range, and other details not evident in the drawing, which will help in identification. The text on the facing page gives all the essential information that the illustration does not show.

The scientific names used are those of Gray's *New Manual of Botany*, seventh

edition. Preferred common names were selected with the aid of *Webster's New International Dictionary*. As is well known, many of our early botanists, who wrote the original descriptions of our flowers, did not have an accurate knowledge of some of the common colors. In Mrs. Hausman's book, much has been done to correct these faulty descriptions of color. It is interesting to note that the work on this attractive little volume began in 1918 with a series of wild-flower drawings made for that beloved teacher and founder of American Nature Study, Professor Anna Botsford Comstock of Cornell University. This little volume can be recommended without reserve.

CLYDE FISHER.

## ANTHROPOLOGY

----- by A. L. Kroeber

Harcourt, Brace & Co., \$7.50  
836 pp., 42 ill.

THE first edition of this now famous text was published 25 years ago. It was also the first American text to cover the entire subject of anthropology as conventionally taught in our universities. For that reason, as well as because of its intrinsic soundness, it rapidly became standard throughout the country and indeed in many foreign universities.

The present edition is the second, and although the general pattern is the same as the first, its content has been largely rewritten in the light of new discoveries, recent theory, and the author's own development. The four-fold division of

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anthropology into physical anthropology, linguistics, ethnology, and archaeology are recognized, and each field is covered serially. The treatment of each of these subdivisions is remarkably well rounded as one would expect from the erudition of the author, and, in their totality, they present the best introduction I know to the subject of anthropology.

In a book of this length (849 text pages), covering a great range of subject matter from fossil man to the problems of personality in culture, it would be miraculous not to find some comment or other to which a critical reader might object. I confess I found several. But these seem minor and insignificant blemishes in the monumental achievement of the whole volume.

HARRY L. SHAPIRO.



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Photo by A. J. Black

▲ "OUR 73-foot, Diesel-engined launch, 'Alert,' lying at anchor in a mainland harbor. Owned by our captain, A. J. Black, she was subsidized by the New Zealand Government to carry our party to the Snares"

**H**AS anyone ever written for NATURAL HISTORY from a sub-antarctic island? There are ten of us here, nine men and I, for about two weeks of the southern spring, late November and early December, 1947. My husband, Robert Cushman Murphy, Chairman of the Bird Department of the American Museum of Natural History, besides being on his regu-

lar job of studying oceanic birds, is creating the Sub-Antarctic Exhibit for the Whitney Hall of Pacific Bird Life. Watching an exhibit planned, collected, preserved, and crated, from the ground up, should be a "must" for every woman married to a museum man. Our naturalists, if they are to be good naturalists, live their jobs twenty-four hours a day. One's self needs to

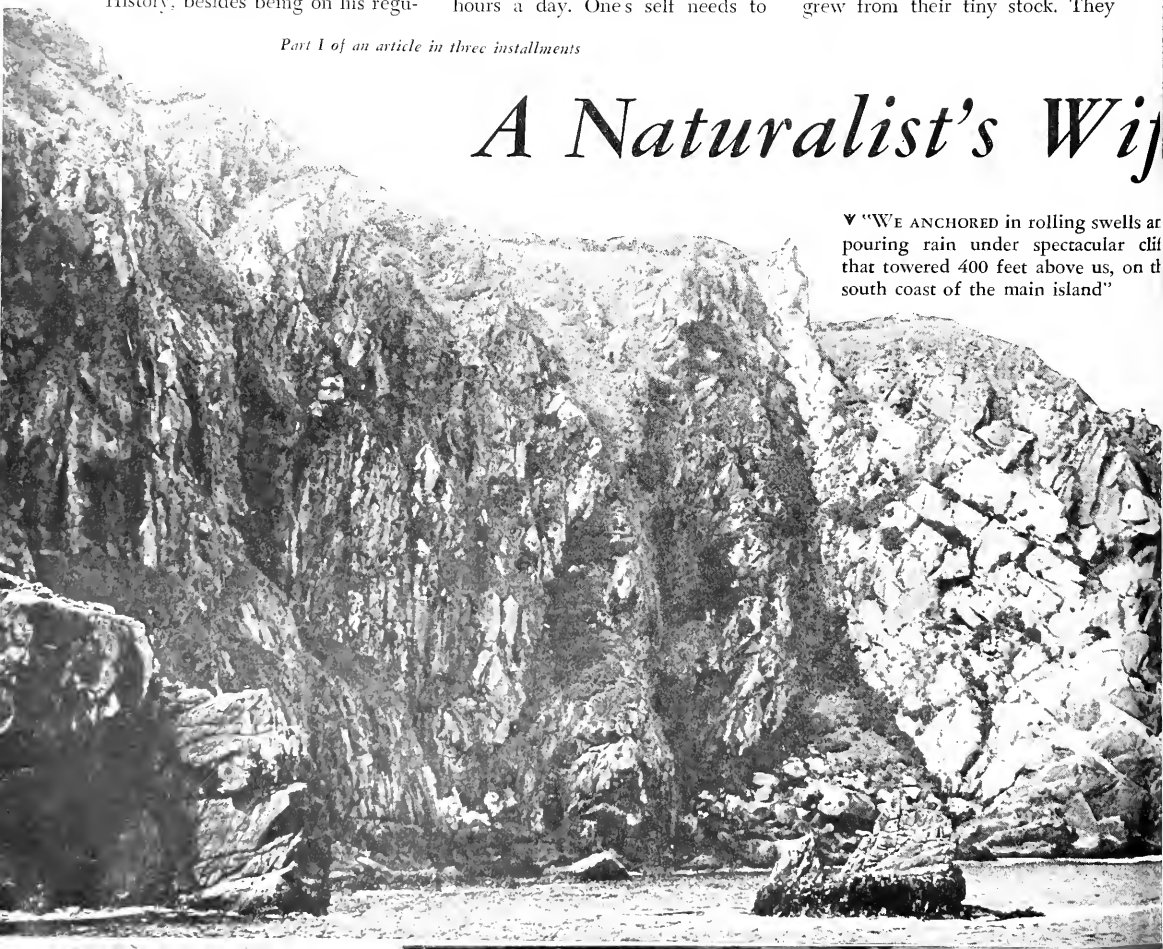
get under the skin of such jobs, sharing not only in the thrilling adventure but also in the driving urgency of the work.

The Snares Islands were discovered by the English navigator Vancouver in 1791. He described them as a "very dangerous cluster of barren rocks, seven in number, twenty leagues from the South Cape of New Zealand." There is almost nothing written about them. Very few people, and no scientists, have ever stayed on them. In 1803, a man named Bass quite appropriately asked the King of England for fishing rights at the Snares, the Penantipodes, and the Bounty Islands. In 1810, Captain Keith of London, short of rations on his schooner "Adventure," stranded three men there, providing them with an iron pot, a half bushel of potatoes, and a quart of rice. These men lived for seven years on seals and birds and the potatoes they grew from their tiny stock. They

Part I of an article in three installments

## A Naturalist's Wife

▼ "WE ANCHORED in rolling swells as pouring rain under spectacular cliff that towered 400 feet above us, on the south coast of the main island"





collected 1300 sealskins and built five huts made of sealskins. After seven years, Captain Coffin (from Nantucket, I presume) brought them off in the United States vessel "Enterprise."

These are the only records of people living on these islands. Even sealers have but rarely visited them. Maori muttonbird hunters used to go to them for short seasons of collecting young birds in large numbers, which they smoked and then packed in bags made out of the giant kelp. They still go to other islands but not to the Snares. Scientific parties have landed, choosing their weather, for three or four hours at a time. The New Zealand naturalist, Guthrie-Smith, in *Joys and Sorrows of a Naturalist in New Zealand*, has a short chapter on the Snares Islands. They are so far from shipping lanes and lie in such dangerous seas that the New Zealand Government built and equipped a 'Castaways' Hut on the largest is-

He added that the captain did not dare take a woman.

I wrote back saying that after a long life one learns that many things are of more importance than mere danger. I pointed out that, as is now told in my husband's book, *Log-book for Grace*, I had been partially responsible for his career in oceanic birds. In 1912, he had declined the opportunity to go to South Georgia because of our wedding date set for June. If I had not urged him to reverse his decision, saying we would marry before he left, his genius might easily have turned to another direction than birds of the ocean. Consequently, I longed to see those birds. I had said for 35 years that I could not die till I had seen Bob's ocean birds. This was my chance. So I wrote to the New Zealanders, following Bob's own request, and told them all about it, ending with:

"As for roughing it, I have just been camping with one of my sons

and three of my grandchildren, all sleeping on the ground. There is no roughing it you can do that I can't take."

New Zealanders are an understanding people. They wrote that I might go. On my arrival in Auckland, however, they showed me movies of fearful antarctic storms and shipwrecks. Of course, I did not turn a hair and kept a poker face when I saw them smiling at each other. I knew it would be a hard trip, but it was my chance to see what South Georgia is like. There are no glaciers at the Snares or snow in summer, but the birds and beasts and gales are the same.

We ten met at Bluff, the southernmost town of New Zealand, a friendly little flower-filled town rolling downhill into its tight little harbor. We walked down the long wharf to "Alert." It was low tide. The 73-foot launch, owned by Captain Black and subsidized by the New Zealand Government for our trip, lay far below the wharf. There was no ladder, and no move was made to help me down. I handed Bob my purse and slung aboard. Not a word was said, but I had a feeling that a test had been set—and passed.

"Alert" danced and stood on her head across Foveaux Strait to Stewart Island. By holding on tight, we all managed to stay aboard. I was too busy to be sick, for I was watching albatrosses flying. They

▼ "THE TON-AND-A-HALF SEA LIONS are sluggish on land, yet I definitely avoided any closer relations than this"

## the Sub-Antarctic

A woman finds thrilling adventure on a cold, forbidding island, sharing with explorers their experience in the field

By GRACE E. BARSTOW MURPHY

Photos by ROBERT CUSHMAN MURPHY unless otherwise credited



land, about 1887. There is no record of its having been needed until the night our party landed.

There is a story attached to my inclusion in an expedition going to such a place. Our New Zealand colleagues were at first far from enthusiastic at the idea of having a woman along. Our leader, Dr. Robert A. Falla, Director of the Dominion Museum in Wellington, whom I had long known casually under the urban conditions of New York, wrote to stress the danger.



swooped and soared so closely that I reached out my hand in instinctive thought to touch them.

Their flight is everything that has ever been written about it, including all the descriptions of their best biographer, my husband. It is the poetry of motion in excess of poetry and into a world where music alone can partially express its rhythm. Petrels run along the water, often flying with the contour of the ocean heavings. Man-o'-war birds fly high above, so that a favorite occupation of mine has always been to lie on my back on soft-swelling Pacific bathing waters, watching the man-o'-war birds halfway between my eyes and heaven. But albatrosses! All levels are theirs. Now high, now low, now at sharp angles to the ocean with one long slender wing tip almost cutting the water, they express the joy of creation as does nothing else in Nature. I am sure that when the Lord rested on the Seventh Day, he broke his rest a little and made the albatross as an expression of his feeling. No scientific research has yet explained to satisfaction their soaring flight with hardly a tremor of a wingbeat.

The albatrosses in Foveaux Strait are mostly small-sized ones, perhaps six to eight feet across the outstretched wings, as against the ten or eleven feet of the Great White Wandering and the Royal. The smaller ones are called molly-mawks. Their various scientific descriptions are fully included in *Oceanic Birds of South America*.

On Otago Peninsula, near the university city of Dunedin, we had called on nesting Royals—the very form that Bob had himself named *sanfordi*, to honor Dr. Leonard C. Sanford, who is the best patron of birds any museum ever had. These Royals incubate their eggs for eleven weeks, and neither hell nor high water—much less friendly visitors—can frighten them off their nests. You can approach to within bill's reach, if you're willing to risk a hard snap on arm or hand. Their whiteness is the whitest whiteness I have ever seen. Herman Melville, in *Moby Dick*, uses such phrases as "wondrous, bodily whiteness of the bird," "the white thing was so white," their "unspotted whiteness." I had forgotten Melville's words when I was at the nest, so was free to be utterly absorbed in contemplation of personal discovery. One cannot take one's eyes away. For the first time in my life, these nesting birds made me regret the heaped-up decades that leave me too few years in which to remember albatrosses. A male dropped beside his sitting mate. The two entwined their necks and bills, unconscious of our presence, in mutual affection.

We lay that first night in a beautiful landlocked harbor at Stewart Island. At dusk, Cape pigeons, another of Bob's South Georgia birds, frolicked near the boat, with the charm that petrels always have and without the fear ingrained in birds nearer to civilization.

But the Snares were our objec-

tive: getting there our captain's problem. Though weather reports were not good, Captain Black decided to make a southward dash the second night, following a fascinating day ashore on Stewart Island.

We ran into heavy weather at once. Bob, in spite of having lived for nearly a year in a whaleship in the South Atlantic, wrote in his notes that he had never seen dirtier weather than that night south of Stewart. The wind blew a full gale of eight on the Beaufort scale. "Alert" is not a pleasure boat. The bunks are narrow, hard, without combings and, of course, with nothing as effete as sheets. We lay in our clothes in blankets and hung on. Several of the men said they were braced hand and foot all night. I woke up once to find half of me in mid-air across the cabin, but enough of me remained in my bunk to haul the rest back. Almost everyone was sick. I did well till thirst drove me across the cabin in the dark to the cup of drinking water I had placed with care in the washbasin to keep it from spilling. Thrown in every direction, I managed to get hold of the cup, taking a big draught before realizing that the green toilet soap had slipped into it and lay soaking. That was my finale.

The gales increased. We were forced to turn back to Stewart Island. Even had we made the Snares, there would have been no chance of landing. We anchored quietly at Port Pegasus, a harbor on the southern shore.

This third night we faced a second beating, everyone dreading it in that cheerful way in which people face such things. The boys, Roland and Hugh, groaned but grinned.

This time we made the Snares. Bob came down in soaking oilskins to wake me up and tell me how

◀ "JAGGED ROCKS foamed with the lashing of the waves. Fur seals torpedoeed through such gulches as this one or played about our vessel!"



captain's reports black de- and dash ing a fas- Stewart rather at ing lived ship in e in his dirtier outh of full gale t scale at. The without th nothing lay in and hung and they foot all and half cabin, d in my Almost well fill e cabin drinking care in m spill- ction, I the cup, e realize- up had soaking.

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◀ "THE EAST COAST of our island presented the only landing place. Boat Harbor entrance lies behind the point in the middle distance. Tussock grass and the daisy forest fill the foreground"



▼ BOAT HARBOR. The cove was so narrow that Captain Black turned our small craft and backed in. Thousands of penguins welcomed us"



▲ "WE MOORED to gnarled daisy trees"



wonderful was the approach to the rocky islands.

I clambered up to majesty superb! There was a heavy northwest storm on. We anchored in rolling swells and pouring rain under spectacular cliffs that towered a straight 400 feet above us. Their shape and appearance grew into one's eyes with as permanent an impression as lens on film. White water poured between them and outlying rocks. Oceanic birds were everywhere. The majesty of the scenery seemed even more subtle than that of the Grand Canyon. The latter bursts into one's vision when one is comfortable and warm. The effect is instantaneous. These Snares cliffs seeped through and through one's being during the hours of a long, cold, rough, and miserable day.

We did not even have food, for the exhausted crew of four slept beside the galley entrance.

Mr. Newcombe, of Internal Affairs, botanist and artist, handed me something hard and cold:

"Have an apple?" It was terrible.

I said, "Can't someone raid the galley?"

Mr. Baird, our geodolist and weatherman, volunteered, returning in triumph with one plate of cold sausage and another of sweet coconut crackers. We shivered but laughed at the horrid combination, and did not leave a crumb.

Time dragged, but the scene was matchless. Fur seals played about us and clambered on the cliffs. We rolled and pitched at anchor in our little lee, with nothing between us and the South Pole. The Islands

make a semicircle facing south. Had gales grown heavier to crash us against the cliffs, no one could have survived. Had we been forced to run to sea, there would have been no place to go. The only shelter for landing is a tiny cove on the east side of the mile-and-a-half-long island—its entrance in the gale's track.

At four in the afternoon the winds moderated a little. It was essential to get ashore and start the work of settling. Bob Falla had said it would take ten hours to get the tents up, and the work must start at dawn.

"And if it is raining?" said I.

"It will be terrible," said he—and later I knew why.

The unloading alone of all our material would take hours: our



◀ "NEAR THE LANDING: at upper left, white-blossomed speedwell (*Veronica elliptica*); foreground, tussock grass similar to the South Georgia tussock"



▼ "THE LONG, brown, restless kelp, forever stirring"



food supplies, tents, and all items of our living, with instruments of many kinds, boxes, lumber, formalin, and six large drums of drinking water. It was imperative to get ashore. Bad as the weather was, it could grow worse and drive us back to Stewart. The work must not be lost.

The anchor was hove up from its twenty-fathom depth. Yet we did not start at once, for the curiosity of the naturalist is eternal. If he were stood up against a wall out of doors to be shot, his last words would be, "By Jove, that bird makes a record," following it with his eyes, oblivious of the rifles.

So we crept up closer to the cliffs to see the seals and birds. The walls were already so near one felt one could touch them. Their straight sides continued straight down into deep water. The dark seals and dark brown rocks merged in similar color. Grass grew in the depressions of the rocks, and, stunted trees clung high above us. Cape pigeons and South Georgia petrels flew about us. A skua passed—a big bird with ugly habits, which I have only just come to enjoy and like. The men speak of its intelligence with admiration.

Immediate human needs could wait. Yet finally we left the gorgeous spot we will never see again and edged along the restless coast, holding on with hands and feet to stay aboard. Jagged rocks foamed with the lashing of the waves. We steamed between two of these scenic wonders, without much space to spare on either side. I was taking comfort out of thought of our captain's knowledge of rocks and

ledges and depths, and said to Bob Falla:

"Has Captain Black been here often?"

Bob bit off crisp words: "He has never been to the Snares before."

He was navigating by the color of the water, which took on meaning even to my unpracticed eyes. I felt no fear but instead the uplifted stimulus of danger. There was no spot for any landing in case of need. It did not take much imagination for the tales one had read about castaways to become graphic. One of the worst aspects must be the ice-cold water. The thought of that pierced through me.

We reached the tiny inlet the men had shown me on the map. A dinghy was lowered. Bob Falla and Alister, our student sailor, went ahead to explore and then waved to us to follow. The cove was so narrow that Captain Black turned our small craft and backed in! Bob Murphy said later that not one skipper in ten thousand would have risked it. Yet anyone would trust Captain Black's judgment and his general knowledge of New Zealand waters and their habits.

The cove was smooth—amazingly, all motion stopped. We moored to knarled daisy trees and rocks. The trees grew out of the ledge about eight or ten feet above the water. Until we were fast, our men worked ceaselessly, pushing us off the thick and heavy branches. New Zealand is full of scores of kinds of daisy trees belonging to the family Compositae. I had seen many late ones at Stewart and on the mainland, covered with white flowers exactly like our field daisies.

Penguins leaped all about us, diving in and out of the water at so fast a clip as to cover distance almost as if they were flying. Penguins look so much like porpoises that Bob said when he first saw them at South Georgia he thought he had discovered a new species of tiny porpoise. They gather in groups and play. They turn on their backs and wash their white shirt fronts. They need good scrubbing, as they live in mud.

Sea lions and solemn penguins sitting on the rocks; exquisite antarctic terns all about us; slender, gray gulls; the long, brown, restless kelp forever stirring; the eve-

ning flight of millions of mutton-birds beginning over our heads; the angry seas outside our little cove bursting against the rampart cliffs—all engrossed me with the beauty of such far-off, unknown surroundings. As the captain stopped a moment beside me, I burst out in rapture:

"Oh, have you ever seen a more beautiful spot?"

"Yes, HOME," said he so that I jumped. "Those rollers are backing up in here. I can't let you sleep aboard tonight. I've got to run for it."

It was nearly six. At top speed the landing of supplies was completed at eight, with the loss of one water drum. "Alert" rushed off to safety. We ten bedraggled people had been set down in rain and gales and cold and mud and darkness, with no way to get tents up or food unpacked that night.

The Castaways' Hut was Mecca. With its corroded roof and mud-filled interior, it fulfilled its purpose after waiting 60 years. Little did its builders guess it would harbor a group of naturalists in 1947. Little did its builders dream that

the ship's biscuit would still be edible, though far from enjoyable. The wax vestas did not light. They bore the label, "R. Bell & Co., London. Establ. 1832." The reading matter included a water-spoiled novel, *Those Bad Blue Eyes*.

The boys cleaned out a few hundredweight of mud. Mr. Stead and the Major, our two nonprofessional ornithologists, stretched a tarpaulin over the roof and laid one on the floor. Duffel bags ranged the walls, both to keep them dry and to give us backs to lean against.

The ugly little hut, only about 8 by 12 feet, was still half filled with crates too big to move out that night or to open inside. The roof was so low we could not stand up straight; people were shorter in the 1870's and '80's.

We all filed in, lady first, of course, so that I drew one wall, a large crate at my knees, a large husband who is not at all a jack-knife, and a duffel bag filled, apparently, with bricks.

While the men had been landing the stores, I had made sandwiches and tea in the galley. Left-over sandwiches, chocolate out of

my purse, Mr. Stead's fruit cake, and some cans of orange juice were all the food we had. Water seeped around the tarpaulin and dripped on us. Some blankets appeared, and we all curled up "to sleep." Cramps were almost intolerable. I could only think of the one idea someone gave me before my first baby was born: "It has got to be over sometime." Bob had his own problems, and I could not lean on him even though I was jammed against him and between the hard wall, crate, and bag. I tried to ease us both in still another bit of adjustment to our position on the floor. I couldn't even grouse, for I was on the Snares on sufferance. Then, too, there was the consciousness of the privilege of being there, knowing at firsthand what men experience in the field. To create our Snares group, Bob not only has to have expert knowledge of his complete environment in ornithology, botany, geology, photography, and so forth, but he also has to take whatever discomfort the environment presents, plus working fast at least sixteen hours a day.

A week later I read Bob's report in his notes of that ghastly night. He ended: "Grace was the only one who seemed to enjoy it."

▼ "OUR CONSTANT SIDE SHOW: the Snares yellow-crested penguins, which live nowhere else on earth"





# Trade-Marks of YESTERDAY'S GLACIERS

A scattering of diamonds, broad fertile fields, and the boulders that plague the New England farmer—all are the work of the great ice sheet, whose visiting cards the intelligent observer can readily discern as he traverses the countryside

By RICHARD FOSTER FLINT

*Professor of Geology, Yale University*

A RANGER was pointing out some of the geologic wonders of Yellowstone Park to a group of tourists. At the end of his talk one of the ladies in his audience approached him. "Did you say," she asked in a tone of wonder, pointing to a six-foot boulder perched precariously on a near-by knob, "that that big rock was brought here by a glacier?"

"Yes, ma'am," replied the ranger.

"Well, but where is the glacier now?"

"Ma'am, it's gone back after another rock!"

The ranger might not have been entirely serious, but broadly speaking, his remark goes for nearly all of the countless boulders strewn across northern United States and Canada—and for the smaller stones, too, and for the "earth" that lies upon the solid bedrock of this vast region. Like huge, frigid bulldozers, glaciers plowed across the country, ripping up the surface rocks, deeply scratching them, grinding them up, and smearing the product far and wide over the territory beyond. Those glaciers once covered a third of the world's land area, but the shrunken glaciers of today are barely able to cover up a tenth of the lands, and nearly all of that reduced amount is concentrated in the Antarctic Continent and in Greenland.

Anyone who has seen a big bulldozer at work knows it can push amazing amounts of rocks and earth. But a glacier can do still better. It develops a pressure of

30 tons per square foot for every thousand feet of thickness it possesses. And some big glaciers are several thousand feet thick. This explains why grooves are gouged out of hard granite rock by stones frozen into the base of a glacier that flows slowly across it. Just as a carpenter's plane, cutting across the grain and coming to the end of a board, breaks off chips of wood, so a glacier, coming to the end of a hill or knob of bedrock, ceases to groove the rock and instead quarries out pieces which break off along the cracks that traverse all rocks. This creates a difference between the smoothed front sides and the quarried, cliffed rear sides of the hills. From a "one-sided" landscape of this sort we can easily tell which way the ice was moving.

All through northern United States and southern Canada the glacier was moving southward. The grooves and scratches and the "one-sided" knobs of bedrock tell the story. So, even better, do the far-traveled boulders deposited by the ice. Some of them have traveled 500 to 700 miles from the places where they were wrenched out of the bedrock by the heavy glacier. Matching up a boulder with the patch of bedrock from which it came is a fascinating game played by geologists. The method is the one used by Sherlock Holmes to trap a criminal, when he matches up a bit of clay on the criminal's shoe with the soil at the scene of the crime. The rock has to be of a distinctive, easily recognizable kind,

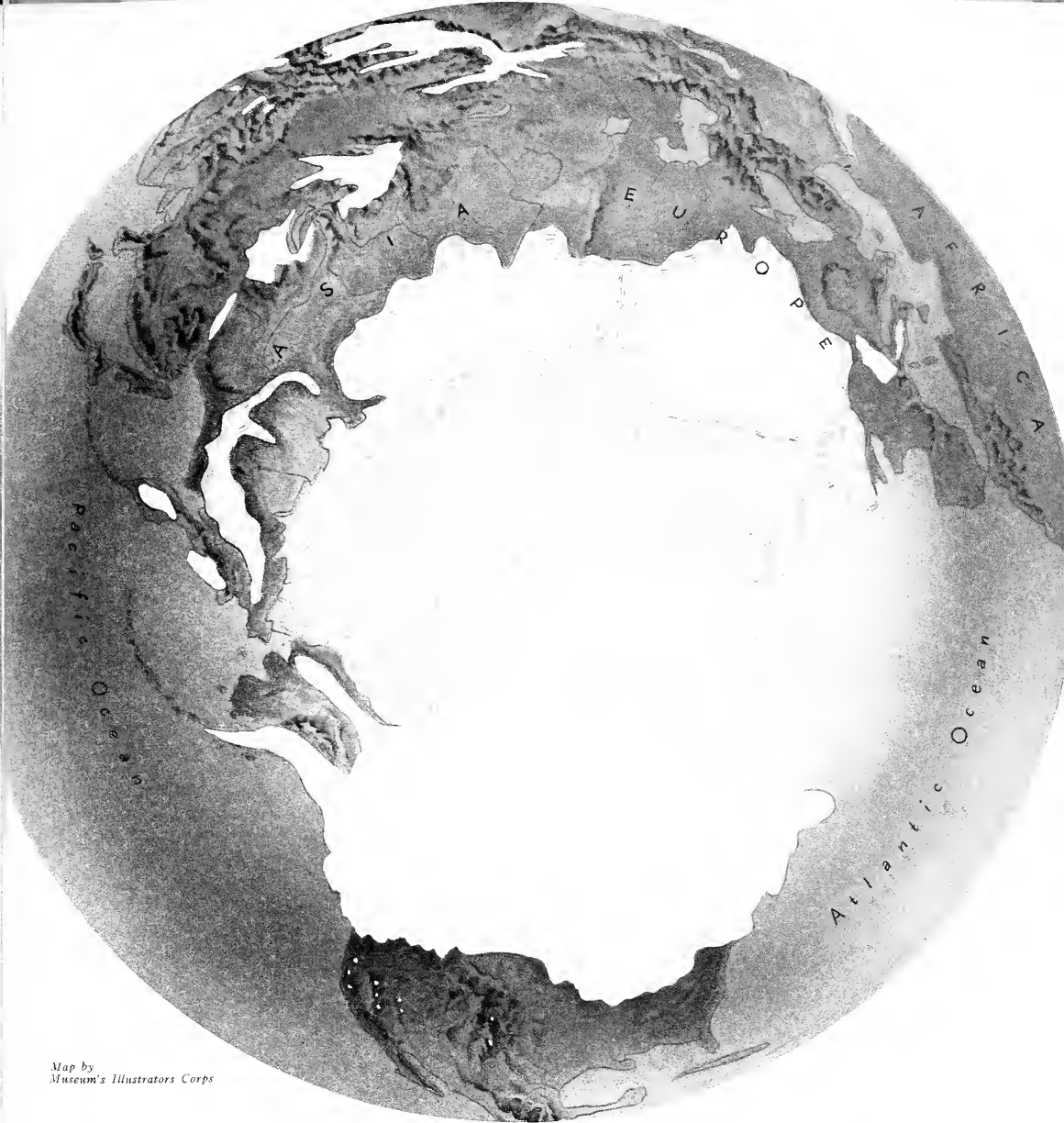
and its "home area" has to be known. Boulders of this kind are known to geologists as "indicators," because they indicate the place of origin and hence the direction and distance the glacier traveled.

Most indicators are no more than a yard in diameter, but a few boulders of jumbo size are known. One near Conway, New Hampshire, measures 38 by 40 by 90 feet. Near Calgary, Alberta, is another, now split into two pieces, with a combined measurement of 25 by 55 by 160 feet. To move this much rock, about 350 railroad gondola cars would be needed; yet a glacier picked it up and transported it for at least 50 miles, apparently without the slightest difficulty.

Some indicators have not only scientific value but commercial value as well. Mining prospectors in eastern Finland found many boulders containing copper ore. They did not know the bedrock source, but they realized that if they could find it they would have a valuable copper deposit; so they searched the district for copper-bearing boulders and plotted the locations of hundreds of them on a map. The boulders formed a fan-shaped area, widening toward the southeast and with an apex at the northwest. The fan had been made by the gradual spreading-out of the ice as it flowed southeastward. Reasoning that the source of the boulders must be close to the apex, they made some exploratory borings down through the glacial deposits into the bedrock beneath,



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Map by  
Museum's Illustrators Corps

discovered the copper, and located what later became Finland's most productive copper mine.

An even more valuable mineral deposit is known to exist, though it has not yet been discovered. Many years ago a Wisconsin farmer, digging a well in glacial soil, turned up a glassy stone. Idly curious, his wife took it to a jeweler in Milwaukee, was offered one dollar for it, and accepted. The jeweler later sold it to Tiffany's for a large

▲ ONLY YESTERDAY in the calendar of geologic times the great ice sheet spread into the United States and parts of Europe and Asia

sum. It was a diamond weighing 15 carats.

This discovery, not unnaturally, started an energetic burst of plowing and well-digging among Middle Western farmers, and they got results. In all, eleven large diamonds were found, scattered through the states of Wisconsin, Michigan, Indiana, and Ohio, and

no doubt thousands more are still lying in the glacial deposits. Plotted on a map, the ice-borne diamonds were seen to occupy an area that narrows toward the north, in the direction from which the glacier moved. The source of the diamonds, in the bedrock, must lie to the north. So far, so good. Various indications suggest that the source



*Photo by Charles C. Bradley*

▲ **HILLS STREAMLINED** by the glacier make Wisconsin farmland. The thick ice sheet, flowing from right to left, molded the earth beneath it into long teardrop-shaped hills

is somewhere in the Muskeg Country, north of Lake Huron. A syndicate was formed by eager enterprisers, equipment was assembled, and prospectors were sent out. The prospectors searched diligently but without success. No one doubts that the diamonds are there in the rocks below ground. It is just that the lakes, swamps, and dense subarctic forests made the hunting too difficult. Interest died down. But someday someone may find in southern Canada a diamond pipe of the kind that has made South Africa, and the name of De Beers, famous. The glaciers have supplied clues but not the final secret.

All the signs of glacier work lie north of a rather definite line. The line runs through or near New York City, Reading, Youngstown, Cincinnati, Louisville, St. Louis, Kansas City, Yankton, Bismarck, and Great Falls. It marks the farthest limit reached in the United

States by the northern glaciers of former times.

The indications of glacial movement show that in the foothills of the Canadian Rockies, along the new Alaska Highway, the ice flowed west. Far to the east, in Labrador, it flowed east. And across the Canadian islands in the Arctic Sea it flowed north. From this information geologists have reconstructed a map of the former glaciers. From the Atlantic and the Arctic to the Rockies the country was covered by a vast ice sheet, hundreds and in many places thousands of feet in thickness. When this glacier was most widespread, its geographic center lay in the vicinity of Hudson Bay. Fed by falling snow, the ice sheet spread slowly over the country like batter spreading over a griddle. The icy frosting overtopped such highlands as the White Mountains, the Adirondacks, and the Catskills. In

big valleys like the Mississippi and the Hudson, great tongue-like protuberances of ice advanced ahead of it.

From the Rocky Mountains to the Pacific Ocean, and from the State of Washington to Alaska, a separate great system of glaciers capped the mountain ranges and filled up the deep valleys between them. These glaciers were fed by snow squeezed out of the warm moist winds from the Pacific, just as the coastal mountains squeeze moisture out of the westerly winds today.

These two great masses of ice—the glacier system in the western mountains and the vast ice sheet farther east—met and touched and mingled at the eastern foot of the Canadian Rockies, to create a continuous ice cover from coast to coast. Six million square miles of glacier ice covered up nearly all of Canada and a lot of the best real estate in the United States. And the land adjacent to it, although not actually overwhelmed by the ice, was none too hospitable, for the cold winds flowing down-

ward and outward off the icy plateau kept the forest at a distance and only permitted the presence of tundra plants and animals. There is no good evidence that man inhabited North America at the early time when the glaciers were most extensive. If any people were here, they probably lived at a respectful distance from the cold and barren ice, in the more temperate country where it was easier to keep warm and find game.

The great ice sheet dealt very differently with different parts of the United States. From the farmer's point of view it improved some regions and damaged others. No very complicated statistics are needed to prove that Iowa farm land is richer and more productive than that of New Hampshire. But without the activities of the ice sheet, Iowa would have been less productive and New Hampshire would have been more so. This is because the advancing ice sheet encountered in New England a very different kind of terrain from the country it traveled over in the lowland region that stretches from Ohio westward to the Dakotas. In New England the rocks are predominantly granite and granite-like. The invading glacier readily scraped away the thin soil and thereafter was unable to do much damage to the obdurate bedrock beneath, other than to quarry out blocks from the rear slopes of hills. In consequence, when the ice melted away it left a lot of bare bedrock and a scanty glacial soil full of stones and big boulders. The stone walls between New England fields testify to the backbreaking labor with which the colonial farmers tried to clear their fields, until many of them gave up and emigrated to the Western Reserve.

The farmers that settled the Western Reserve knew little or nothing about glaciers, but they understood well enough that the lowlands that stretched westward from Ohio were a great improvement on the New England farms they had left. Indeed the western lands were different, despite the fact that they had been overridden by the same ice sheet that plowed

through New England. This is because the rock strata beneath the lowland consists mainly of shale and limestone—weak, soft rocks that yielded readily to the glacial plow. So vulnerable were they, indeed, that the basal part of the glacier ice soon became glutted with the limy silt and clay made by the grinding up of the rocks beneath. Therefore, instead of chewing up more rock, the ice was obliged to deposit the load it had acquired, plastering it thickly over the terrain. The deposited material makes a very high-grade soil and is comparatively free of boulders to boot. Much of our Corn Belt and a part of our Wheat Belt are situated firmly on this rich and thick glacial deposit.

Curiously enough, this glacier-built earth is known to geologists as *drift*. The name goes back more than 100 years to a time when, although the widespread stony earth was a familiar thing, the former glaciers had not yet been thought of. The idea then current was that all this earth—with the boulders embedded in it—had been deposited on the floor of a universal sea by endless icebergs *drifting* down from the vicinity of the North Pole. Some even attributed the sea to the Deluge of Noah's time! Such ideas have long since vanished from the minds of scientists, but the name *drift* still remains.

Pick out, or wash out, a handful of pebbles from the drift exposed

in a convenient road cut or in an excavation for a new building, and you will see inconspicuous but definite trade-marks of glaciers at work. Chances are that a number of the pebbles will be not round but faceted. They will have flat faces made by grinding against the stones which were being scraped under tremendous pressure, in the base of the glacier, against the bedrock beneath. Some of the facets may even have little scratches on them made by grains of sand and other particles of grit that helped to "gum up the works" during the scraping process.

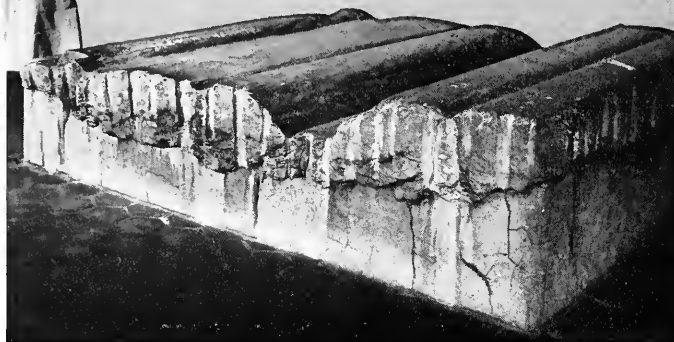
In coastal Alaska, within the memory of living men, advancing glaciers have overwhelmed forests, snapping off the trees at their bases as if they were toothpicks and rolling forward over the debris. At many places in the Great Lakes region, excavations in the bottom of the drift have revealed tree trunks and bits of wood that testify to the similar annihilation of forests by the invading ice sheets of long ago. In one place, in Minnesota, some of the logs from the drift were carefully sawed by investigating botanists. The trees were identified as spruce and tamarack—trees typical of the subarctic forest. When the concentric annual growth rings were closely examined on the sawn surfaces, it was found that the 20 outermost rings were progressively thinner than the older, inner rings. This showed that the

▼ A "ONE-SIDED" KNOB of bedrock. The glacier flowed over it from right to left, grooving and smoothing one side, breaking and quarrying the other





▼ PARALLEL GROOVES cut by the slowly moving glacier in a piece of rock at Kelley's Island, Lake Erie, Ohio. Specimen on display at the entrance to the American Museum



AMNH Photo

20 years immediately preceding the destruction of the trees were exceptionally unfavorable for the growth of even a subarctic tree. Here, from an unusual source, we have the visiting card of the intruding ice sheet. For 20 years the ice crept forward, near enough so that its cold winds created an inhospitable habitat for spruce and tamarack, and then, like a giant steam roller, it simply erased the forest and buried it in a muddy, gritty matrix.

Aside from scraping away the soil and littering the surface with boulders, the ice sheet did not greatly alter the landscape of New England. But in the lowland country south and west of the Great Lakes, it not only built the foundation of a rich agricultural soil but also altered the landscape profoundly. It did so largely by filling the valleys chock-full of drift, thus converting a country of steep hills and moderately deep valleys into the gently undulating plains familiar to westbound travelers when they leave the Appalachian Mountains behind them.

In some places, where the flowing motion of the ice sheet was especially pronounced, the drift was heaped and smoothed and molded into a series of streamline forms. These are visible from the ground, but from an airplane (with low sunlight in early morning or late afternoon) they are striking. The teardrop form of a streamlined

car is designed so that it will offer minimum resistance to the air (a fluid substance) through which it travels at high speed. In a similar manner the teardrop streamlined forms of drift, and bedrock, too, were shaped by the flowing ice (also a fluid substance) so as to offer a minimum of resistance to the ice passing over them. The similarity of nature's streamlined forms to the artificial ones is surprisingly close.

More commonly the drift is not streamlined; its surface, instead, is a gently undulating plain. So broad and monotonous is the plain that the presence of the network of valleys buried far beneath was hardly more than suspected until geologists began to compile the drilling records of the tens of thousands of oil, gas, and deep-water wells that have been drilled throughout the region. Because the exact depth at which the drill passed from drift to bedrock in each hole was recorded, it was possible to reconstruct, on maps, the surface of the bedrock underneath the drift. It was almost as though the drift had not been there. The floors of some of the valleys thus revealed lie 700 feet beneath the farm land that now masks them, while over near-by buried hills of bedrock, the drift is no more than 50 feet thick. Here is a whole stream system, inactive, sterile, and fossilized.

The map of the deeply buried valley system makes clear what a

major job of rearrangement the ice sheet performed on the rivers of Ohio, Indiana, and Illinois. In the old pre-ice days the Ohio River and the Wabash, too, were short, and the Mississippi traversed Illinois not by its present route along the western edge of the state but via the parallel Illinois River, 100 miles to the east. The big river of those days was an extension of the Kanawha, which flowed westward across Ohio, Indiana, and Illinois. Its capacious valley, now well buried beneath the drift, is almost 500 miles long.

It is easy to see how the Ohio River was formed when this big earlier valley was blocked by the outer edge of the great ice sheet. The streams flowing northwestward across West Virginia and Kentucky were dammed up by the ice barrier. Many lakes were formed, and as each lake filled with water the overflow from it simply spilled sideways, in a westward direction along the lowest available route. As these spillways were deepened, they formed a chain that became permanent. When the blockading ice sheet melted away, leaving the old valleys obliterated beneath drift, the water continued to follow the newly established route. This route is what we call the Ohio River. Its valley still shows distinct narrowings that mark the sites of the spillover channels between the temporary ice-covered lakes.

The Missouri, the longest river in North America, underwent an even more spectacular metamorphosis through the interfering tactics of the ice sheet. A glance at a map at right shows that the course of this great stream is abnormal. Gathering its water in the Rocky Mountains, it flows eastward across Montana, following the easterly slope of the Great Plains. But then it turns, and for nearly 500 miles through the Dakotas its course is southward *along* rather than *down* the regional slope. This part of the river is close to and parallel with the line along which the edge of the ice sheet, moving in from the northeast, paused before melting away. In other words, the country on the east bank of the river has

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A BIG BOULDER dropped by the glacier. Sixty feet in height, it dwarfs the farm buildings clustered around it

been glaciated, while most of the country to the west was never covered by ice.

This fact alone leads to a strong suspicion that the glacier diverted the Missouri into its curious southward route. But there is further evidence. Leading eastward away from the Missouri's east bank, and only faintly outlined because they are almost completely filled with drift, are the buried valleys of large former rivers. These are continuations of the large streams that enter the Missouri from the west. What further proof is needed that the ice sheet, encroaching up the gentle slope of the plains from the northeast, blocked the Missouri and many other east-flowing streams

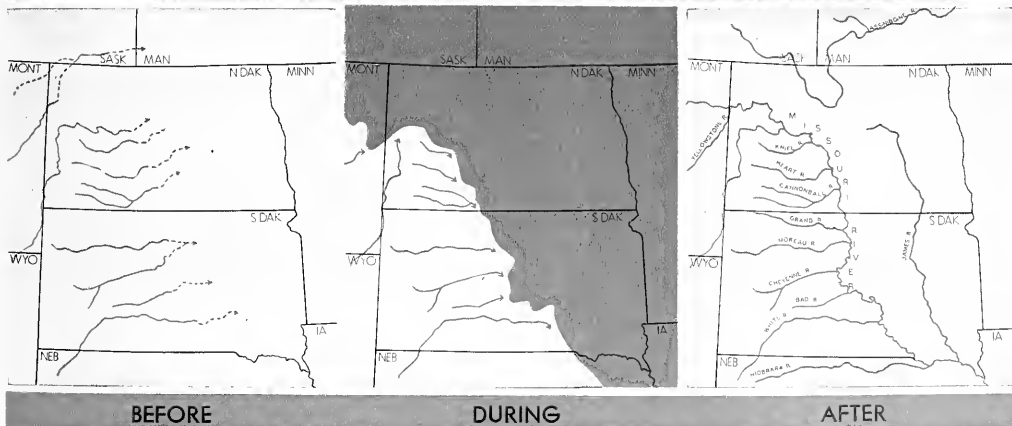
and forced their combined waters to flow southward along the margin of the glacier in a gigantic detour around the blockade?

Because the buried valleys, traced eastward, lose themselves underneath their thick blanket of drift, and because deep wells are too few in this region to enable us to follow them farther, we do not know what pattern the network of rivers formed before the coming of the ice sheet. There is some reason to believe that the former Missouri flowed northeastward into Manitoba, via the Nelson River, Hudson Bay, and Hudson Strait into the Labrador Sea. If this be true, the ice sheet succeeded in leading America's longest river across a

continental divide and in diverting it from the Arctic to the Gulf of Mexico. Thus through glacial power are the lines on the face of the land changed.

Under the influence of today's warm climates, the glaciers of many thousands of years ago have disappeared or have shrunk back into the high and cold regions of the far north. Today they are biding their time. But more than once in the past they have sallied forth into temperate latitudes, and if the changing climate permits, they may come again, bringing with them another load of drift to smear over the land, another command to rivers to seek new courses, another scattering of boulders, and—who knows?—perhaps also a rich gift of diamonds.

#### HOW THE GREAT GLACIER CHANGED THE RIVER SYSTEM OF THE DAKOTAS



Dotted lines show original direction of rivers as deduced from valleys now buried. Solid green represents glacier.





▲ MONARCH BUTTERFLY on a mallow bloom

# Scourge of the Monarch

The deadly larva of a fly brings tragedy to its powerless host

By EDWIN WAY TEALE

(All photographs by the author)

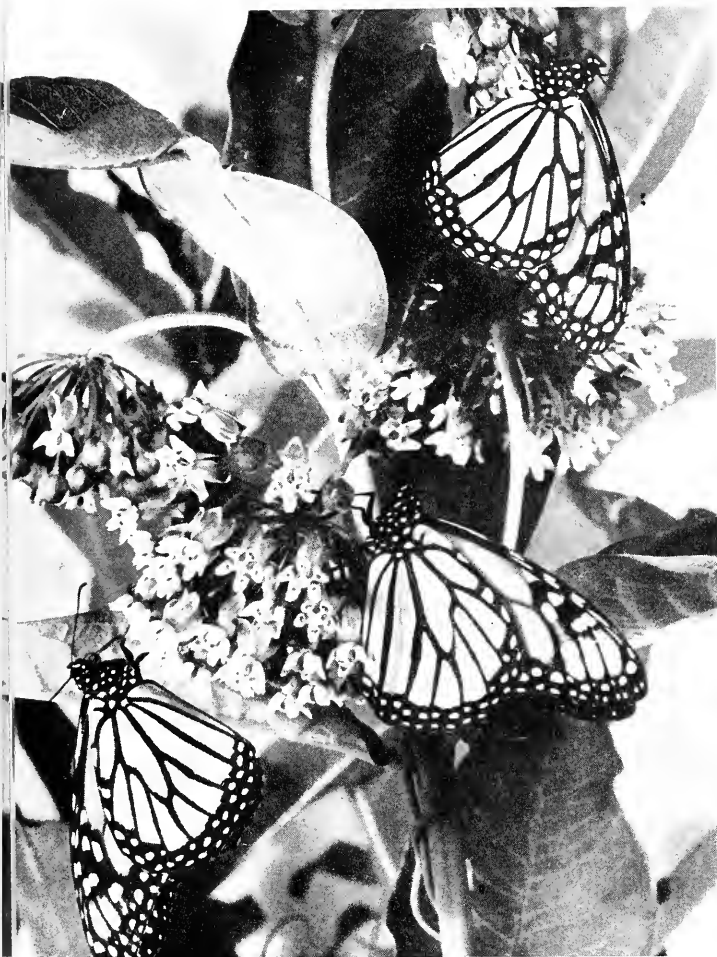
**M**ORE than half a century ago, Charles Valentine Riley, founder of what is now the U. S. Bureau of Entomology, reported that a scourge was wiping out vast numbers of monarch butterflies. Hardly one caterpillar in fifty

was free from the deadly larvae of a tachinid fly.

This carnivorous parasite, *Achaeontoneura archippivora*, is still the chief enemy of the monarch. In our time, as in Riley's, years arrive when it reaches a peak of abun-

dance. Such a peak was marked by the summer of 1945. Everywhere in the East, the larvae of the milkweed butterfly were disappearing, killed by the infesting parasites before they could transform into chrysalids. That summer, on the six-





▲ MONARCH BUTTERFLIES on a milkweed plant

teenth day of August, a strange and fearful thing happened before my eyes and the lens of my camera. It was the final act in the tragedy of a caterpillar, the climax in the work of these dipterous parasites.

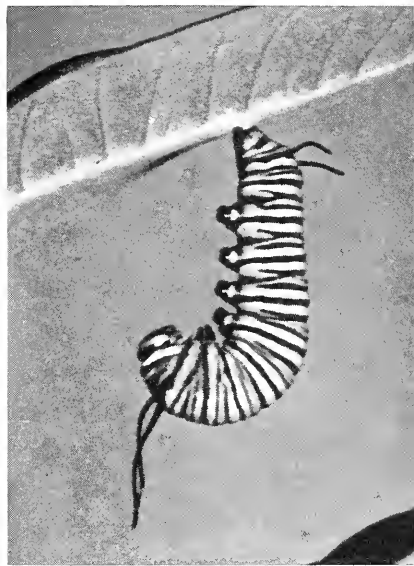
Late the afternoon before, I had come upon a monarch caterpillar just as it had attached the tip of its tail to the underside of the midrib of a milkweed leaf, in preparation for changing into the pupa. It hung with the forepart of its body curled upward so that it formed a letter "J." Evening was coming on, and I brought the plant indoors to photograph the transformation.

All that night it remained as it was. The next morning, at eight o'clock, I noticed that the curve in the "J" had become shallower. Then, suddenly, as though a cord within had been severed, the larva straightened out and hung limp. Its skin was baggy and lumpy. It began to heave as the lumps within pushed and moved. At 9:30 A.M., the first of six white, fat-bodied grubs appeared through the skin of the caterpillar. Each was about three-eighths of an inch in length.

The grub descended to a second milkweed leaf below it. That descent was made at the end of what appeared at first to be a thick



▲ LARVA of a monarch butterfly on a milkweed leaf



▲ THE AFFLICTED LARVA, attached to the underside of a leaf at the beginning of its transformation into the pupa



▲ NORMALLY, the larva would have transformed into a chrysalis like this



▲ THE FIRST of the six parasitic larvae to emerge from the caterpillar and descend to the milkweed leaf and the ground below

➤ ANOTHER STAGE in the emergence of the parasitic fly larva



▲ THE FLY LARVA has reached the ground and is wriggling its way into the soft earth. It will pupate underground

➤ THE PUPA of the parasitic fly



thread of silk. The thread, however, was formed of a sort of mucus-latex which stretched like tacky glue or rubber cement. By means of this stretching rope, the grub descended, as in an elevator, smoothly and without a jar to the leaf below. It rolled and wriggled until it reached the edge of the leaf. Here, the mucus still attached

to its body formed another rope that lowered it half an inch or so before it parted like dough pulled too far. Its drop carried it half a dozen inches to the soil in which the plant had been placed. Here, it pushed its way into the dirt and disappeared from sight. It was hastening to enter its pupating medium.

Later, this instinctive haste to reach the soil was demonstrated when I placed one of the other grubs back on the milkweed leaf. It wriggled and rolled until it reached the edge again. Five times I repeated this experiment, and each time the fly-larva made haste to roll off the leaf. Pupation, however, does not depend upon reaching the ground. The transformation can be made in the open air as well. I discovered this when I placed one of the grubs in a bare glass container and watched it alter to the reddish, hard-shelled pupa. But when the quiescent period is spent underground, the transforming fly has greater protection from its enemies.

Three of the grubs were out by 11:45 A.M. A fourth appeared at 2:15 P.M., another at 2:35, and the last at 4:00 P.M. Each descended smoothly to the second leaf by



▲ THE ADULT tachinid fly, *Acbaetoneura archippivora*, that emerged from the pupa case

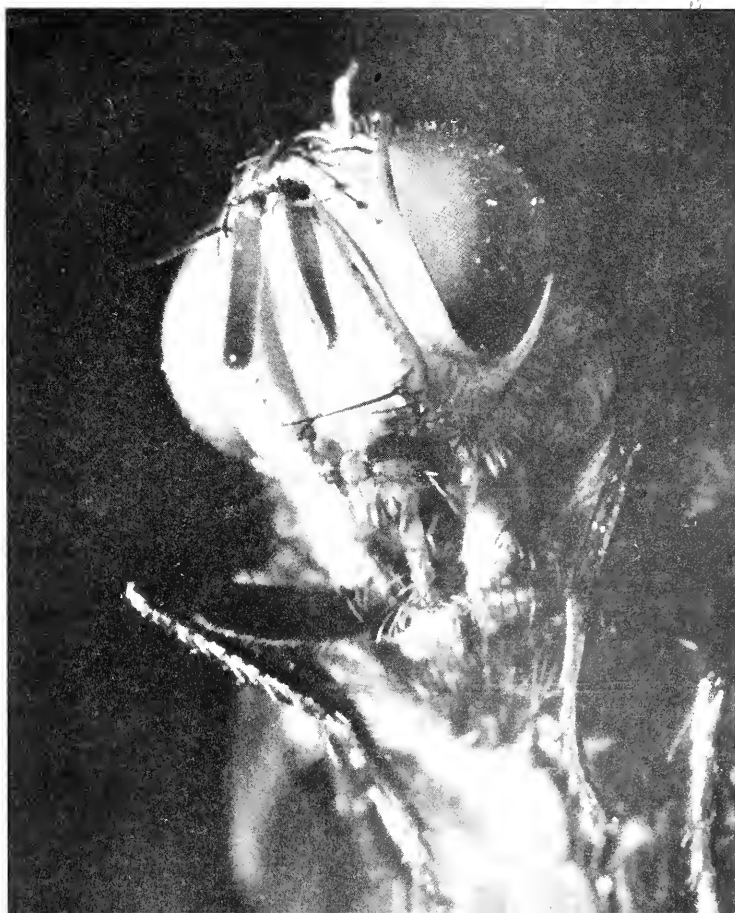
➤ HEAD of the fly. The females seek out other caterpillars to parasitize, and the cycle begins anew

means of an elongating cord of mucus. These cords were like parachutes that could be used only once. They quickly hardened and dried. Within a quarter of an hour, they were so brittle they broke at a touch. After all the larvae had descended, lines of dried mucus extended across the upper side of the milkweed leaf like the trails of a garden slug. Over them, hardening and turning dark, hung the almost empty bag of the dead caterpillar's body.

These events took place on the sixteenth of August. For ten days after that, the pupae of the parasite remained hidden in the earth. Then, at two o'clock on the afternoon of August 26, the first of the pupa cases split open, and an adult fly crept from the ground. It was small and stubby-bodied. Stiff hairs jutted to the rear from its abdomen. Later, Dr. C. H. Curran, of the

American Museum of Natural History, identified the fly as *Acbaetoneura archippivora*. Almost an hour passed before the emerging insect had its wings fully expanded and hardened. The other pupae produced their adults one after the other. All were out by 5:00 P.M. Whenever these newly emerged flies became frightened within the glass jar into which I had placed soil and the pupa cases, they would seek refuge in the earth at the bottom of the jar, burrowing downward among the tiny clods.

Under normal conditions, these adult insects would mate and the fertilized females, riding on heavily veined wings, would fly swiftly about in search of other caterpillars to parasitize. The offspring of these dipterous parasites represent both the start of another generation and the start of new tragedies for the larvae of the monarchs.



BOUNDARY  
NAVAJO RESERVATION  
U.S. DEPT. INTERIOR

◀ AT THE BORDER of the Navajo Reservation, an arid tract lying at the "Four Corners" of Utah, Colorado, Arizona, and New Mexico

# THE NAVAJO most hopeless tribe

Public lack of interest in the Navajo, hunger, ill-health, and the loss of their land and its people show a desperate situation.

By OLIVER LA FARGE  
Photograph by [illegible]

RECENTLY the general public has become aware of the fact that we still have within the borders of the United States a tribe of Indians numbering over 60,000—a cohesive group, predominantly of full blood, retaining its language and a great part of its ancient customs. The public has heard of it; it has been photographed, described in newspapers and magazines, and made the principal subject of a major broadcast, for one unhappy reason—that this remarkable group, the Navajo tribe, has reached a condition of general ill-health, want, hopelessness, and hunger which is a national disgrace.

Those of us who knew and lived among the Navajos in the 1920's thought of them as the most hopeful of all the Indian tribes. We knew that they were the largest, although the highest guesses did not put their number over 30,000. They lived in a remote, semidesert country of great beauty—the greater part of it in northeastern Arizona, with a sizable segment in New Mexico and a smaller area in Utah. Their domain, about as large as

▲ CAPABLE HORSEMEN since the early Spanish days, the Navajos have shown more wisdom than most in fitting their proud traditions into modern civilized life. Yet little has been done to assist their economic and cultural transition. A turquoise necklace and well-tanned moccasins fastened with U. S. silver coins adorn the rider. The wiry horse is shaggy in his winter coat, and scarcity of food is his lifelong lot

\*OLIVER LA FARGE, winner of the 1929 Pulitzer Prize (for *Laughing Boy*, story of a Navajo lad), of the 1930 O. Henry Memorial Prize (for "Haunted Ground"), and of the Guggenheim fellowship in

writing, is an anthropologist by training. He has made three anthropological expeditions to Arizona and two to Mexico and Guatemala. His long residence among the Navajo Indians and his as-

sociation, in various capacities, with organizations dedicated to Indian affairs and services has qualified him to speak as one of the country's leading authorities on the Navajo.

# NAJOS-

## ope tribe of all

ck of inta contributed to their  
health, a of education. Now the  
s people s as a democratic nation

By OLIV FARGE\*  
Photograph by MUENCH

the state of West Virginia, was difficult to reach. No important white settlements lay near it. Although not in any sense wealthy, the Navajos seemed to have a good, secure life, with their flocks of sheep providing their principal income. It looked as if they would absorb our civilization slowly and without destructive shocks, and as if the native culture elements of greatest value would have a good chance to survive. One could look forward to an evolutionary process that would result eventually in a large community of citizens of predominantly Indian blood, carrying with them a proud tradition and enriching elements of their ancient culture as they moved into the main stream of American life.

This optimistic belief was strengthened by their past history. The Navajos are close relatives of the Apaches and with them form a southern offshoot from the area of the Athabaskan linguistic stock, the main center of which is in northwestern Canada and Alaska. Perhaps about A.D. 1000, bands of Athabaskans wandered into the relatively empty areas of the Great Plains. Probably from contact with more advanced tribes to the east, they learned a little farming and how to make crude pottery. Their culture was simple, their possessions few, their organization weak.

THE NAVAJOS



▲ A TYPICAL CAMP SCENE in Monument Valley, including a woman at work on her loom, a small fire around which the children play, and the family burro which is used to tend the sheep

Later, under the pressure of stronger tribes, they moved south and west until they entered New Mexico and came in contact with the sedentary, agricultural Pueblo Indians.

Most of the bands that later became Apaches drifted on, into the waste areas farther south, where they lived obscurely until in the eighteenth century they emerged as

ruthless and deadly raiders. The future Navajos settled near the Pueblos. They learned farming on a new scale, irrigation, weaving, elaborate ceremonies. Their culture was profoundly modified, and yet, while they took over every element that they deemed useful, they did this selectively, fitting the elements into their basic pattern of individual freedom and the deep, psy-

▼ LAMBS graze upon their overburdened range; the loom awaits the fingers of the mother. A desert landscape unmatched in grandeur is their backdrop

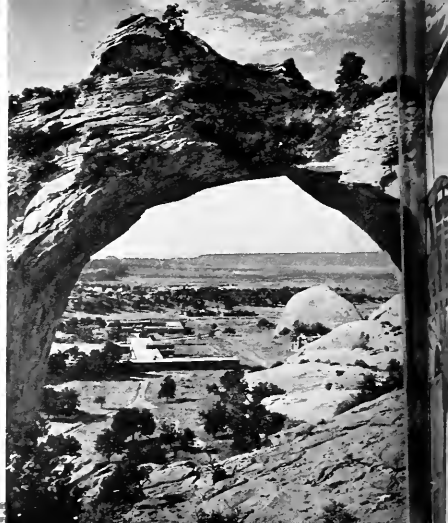






▲Ft. DEFIANCE, on the Navajo Reservation, has a school. But all their existing facilities permit less than a third of the Navajos of school age to receive education

➤WINDOW ROCK, headquarters of the growing Navajo tribe, just south of Ft. Defiance, in Arizona



chological values of their original culture.

The coming of the Spanish led to changes. They acquired the horse. The men's costume changed greatly. They took up wool-weaving, developing an industry that has become nationally, even internationally, famous. They learned the rudiments of metalworking and by the middle of the nineteenth century were becoming skilled in this craft. It should be noted that many of the arts they borrowed from others, they developed beyond the skill of their teachers. Navajo silverwork put the local Spanish silversmiths out of business; Navajo blankets were more highly valued than those of either the Spanish or the Pueblo Indians; their dry paintings infinitely surpass those of their Pueblo teachers.

When the Spanish first encountered them, they numbered perhaps a little less than 2000. By 1850, they had increased to about 10,000. With increasing numbers and the mastery of the horse, they made a further change. Farming became a secondary occupation, while herding sheep became primary—but it was not ordinary herding. They butchered their sheep whenever hungry and regularly replenished and increased their flocks by raiding the Pueblo and the Spanish settlements. They became as fierce as any of the other Apaches and were a scourge to the whole Southwest.

In 1866, Kit Carson broke them in a sharp, fierce campaign. The greater part of them surrendered and were moved to a sort of internment camp at Fort Sumner in eastern New Mexico, although a thousand or so die-hards hid out in the wild mountains and desert. The government offered them a reservation in rich, grassy country in Oklahoma, but they would have none of it. Their one desire was to return to their beautiful, harsh homeland. At length, in 1868, a solemn treaty was made with them, and they received a part of their old domain as a reservation. At that time their numbers were estimated at 9000. Many had been killed in the fighting, more had died on the "Long Walk" to Fort Sumner and during their exile there. Some who hid out were killed by tribes taking a fine opportunity to pay off old grudges. Thus it is safe to estimate that, in 1850, the tribe had numbered 10,000.

Now the Navajos changed again, becoming true shepherds, guarding and increasing their flocks and building up their crafts more intensively for commerce. The women abandoned a heavy, woolen costume adapted from that of the Pueblos (which in turn had replaced the earlier buckskin) and took up their present mode of dress. This consisted of a velveteen blouse and a full skirt of calico or velveteen, modeled after the dress of the officers' wives at Fort Sumner. More slowly, the men changed to

the wearing of manufactured, standard clothes—but they have a way of wearing them, a preference in colors, a use of ornamentation that makes them look anything but standard.

Their capacity for changing and yet remaining thoroughly true to themselves is one of their most interesting characteristics and one of the reasons why they have been looked upon as so hopeful. Their language gives a view of their characteristics. The studies of the Franciscan Fathers early in this century showed that Navajo then had a vocabulary of 18,000 words. By now it has been considerably enlarged. Most Indian languages today are loaded with words taken from the various European languages with which they have had contact. Not so the Navajo, in which loan words are rare. New things, such as the horse, the automobile, the airplane, in their turn, were given names compounded out of Navajo or newly invented according to the Navajo pattern.

The structure of Navajo is difficult; very few white men speak it at all competently. Yet it is so flexible that during the war the Marines recruited a special platoon of Navajos. At a school which was set up for them, they learned an enormous range of military and naval terms, all of which they translated into their own tongue. Then they were sent out as teams for landings in the Pacific, carrying





▲ THE NAVAJOs are still a seminomadic people. The wagon carries everything except the herds of sheep and goats, as the family moves from camping place to summer shelter to winter hogan



► NESSCAYAZZIE, the medicine man: a fine old face that has seen many long winters and many unhappy changes



▲ LITTLE NAVAJO GIRLS, dressed like their mothers with handmade silver buttons, velveteen jackets, and bare feet

on ship to shore communication over ordinary voice radio in Navajo, a code the Japanese could not break.

Such are the people who today are in a desperate plight. What has happened to them? In a sense, they are the victims of their own vigor, of their very success in adapting themselves to the ways of peace. In part, they are suffering from astonishing blindness on the

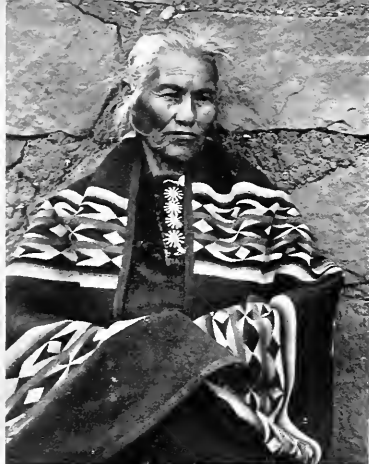


▲ THE WAGON AND HORSES represent much of their worldly goods. Coffee, fried bread, and some meat comprise almost their whole diet, adding up to about 900 calories a day as compared with 1550 in the British and American zones of occupied Germany this past winter

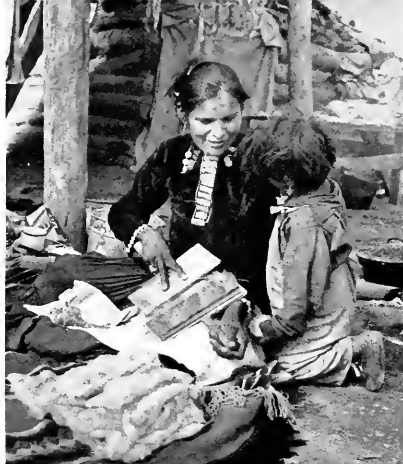
part of white men. In many matters the Indians and the white men, represented by the United States Indian Service, have worked hand-in-hand to bring about disaster.

We can begin with a failure, a broken treaty. The Treaty of 1868

undertook to provide a teacher and schoolroom for every Navajo child between six and sixteen who could be "persuaded or compelled" to go to school. This has never been done, for several reasons. The Navajos themselves, until recently,



▲ THE PAST looks out upon a bewildering present in Navajo land. The well-known Navajo blanket serves as coat, grocery bag, baby sling, and blanket



▲ MOTHER cards the wool before it is spun for weaving, while her small boy asks her a question. A scene beneath the summer shelter, with the winter hogan in the background



▲ A NINE-YEAR-OLD SHEPHERDESS is trusted with the lambs and kids of the flock, miles from the nearest school

were not greatly interested in having their children educated. Some were outright opposed to schooling—from conservatism, from the need of having the children at home to tend the sheep, and because of the suffering and misery that were so common in the Indian schools of the old, bad days.

The Navajo country is difficult to travel in. It has virtually no all-weather roads. The Navajos live scattered all over it. No one knew for sure how many Navajos or Navajo children there were or where many of them were to be found. With the difficulty there was in filling the schools already in existence, the Department of the Interior never felt able to ask Congress for the constantly increasing appropriations that would have been necessary to offer education to them all. It is doubtful if there have ever been school facilities for half of them. Today, of some 23,000 Navajos of school age, by the exercise of the greatest ingenuity, barely 7000 can be crowded into schools.

The blame goes further than the Navajos, the Indian Service, or the Department of the Interior. At least as early as 1930, senators were rebuking the Commissioner of Indian Affairs for not having asked for schools for all. Recently, several delegations from the tribe

have begged the Congress for schools for all, and various congressmen visiting the reservation have heard the same plea. Yet Congress has initiated no action.

The vast mass of the Navajo population, inevitably, is illiterate and speaks no English. Very few have even a complete grade school education. Accordingly, when they face the outside world they are like blind men feeling their way. They are tied to their land, for when they seek opportunities outside, only the poorest, lowliest forms of labor are open to them, and even at such work they are the last hired and the first let go.

This ignorance is the first horn of the dilemma. As citizens of the United States they are in theory free to go where they please, but as primitive illiterates this freedom is meaningless.

The second horn is that their reservation, vast as it is, cannot possibly support their present population. The dilemma should have been apparent long ago, but a curious and most unfortunate sequence of factors disguised it until it had reached its present extreme state.

It is difficult now to determine at what point the size of the tribe became too great for the "human carrying capacity" of the reservation. From 1868 to 1932, the Indian

Service officials, as well as Indian traders and various private individuals and organizations, kept urging the Navajos to increase their flocks by all means. The Navajos responded well. In the 1920's, there existed a modest but genuine false prosperity among them, which arose from grazing upon the reservation more sheep, goats, cattle, and horses than the land could carry. The effects of the resultant overgrazing were apparent as early as 1921; by 1930, they were painfully obvious. The animals were still finding enough to eat, but the time was rapidly coming when it would no longer be possible to graze more than a small fraction of their number upon a ruined land.

Beginning in 1933, a newly awakened Indian Service began putting soil conservation measures into effect. Progressively the stock on the range was reduced until carrying capacity was reached. This meant cutting the number of animals approximately in half. The reduction of the sheep and goats threatened great hardships; the reduction of horses, many of them useless, struck deep at the pride and prestige of the men. Because so few Navajos had any real command of English, it was difficult to convey to them the realities of their problem. Many of them espoused a mystical concept of the relation of



WEAVING, the Navajos have won world fame. At lower right is a spindle and card-loom; on the blanket a bunch of yucca fibers, as a comb on one end, broom on the other



▲ A NAVAJO MOTHER proudly holds her papoose, laced in the traditional cradle-board. In 1850, there were 10,000 Navajos; today they number over 60,000



▲ TWO NAVAJO CHILDREN on the family burro

the sheep to the land, which precluded their accepting the idea that overgrazing could be harmful.

The Indian Service committed a number of blunders, not of principle but of method, in the course of reducing the stock. Added to the misunderstandings and emotions involved, these resulted in an alienation of the Navajos from the Service. Good relations were replaced by a hostility on their part which is still a troublesome factor. There was a change in their attitude toward white men generally. They used to be rather open and friendly, agreeable to strangers, good-natured. Now their behavior varies from guarded to sullen.

Nonetheless, grazing was brought down to carrying capacity, an essential move. The Soil Conservation Service was invited in, and some improvement in the condition of the land was made. In the face of unexpected conservatism on the part of the Navajos, improved methods of herding and better strains of sheep were introduced, bringing about a marked increase in the income per sheep from those remaining.

A great many families hitherto dependent upon sheep now were left with none, or with so few that they could not support a family yearlong. This was in part due to an inequitable, straight percentage

cut which was put across by the small but influential group of Navajos who owned really large flocks. In some places it was due to the stupidity of local officials, in others there simply was not enough grass to enable anyone to have a flock that would guarantee subsistence. The increased income from the sheep remaining did not fill the economic gap, nor did the subjugation of a considerably larger area of irrigated land. Under normal circumstances, the stock reduction should have precipitated an immediate economic disaster.

Disaster was postponed by the very large amount of relief work and work on soil conservation projects obtained for the Navajos. The top officials of the Office of Indian Affairs, like most of the Navajos, allowed themselves to be lulled by this artificial source of income. There were only a few people who insisted that if a capital resource was removed, another must be provided, and that relief work was only a makeshift.

Relief ended with the war. Three thousand six hundred Navajos went into the armed services. This meant that not only was six per cent of the population removed but that they were replaced by allotment checks which constituted an important increase in income. In the acute labor shortage that existed,

thousands more got work off the reservation. Income went to a new high level. Everyone was happy.

The part of the Indian Service that administers the Navajos is known as the Navajo Service. The men at the top of the Navajo Service today, as well as many of their subordinates, are sincere, devoted, and intelligent. Issuance of ration books and other war measures provided the means for the most accurate count of the population ever made, resulting in the reliable figure of 62,000 members of the tribe. Studying the scene with this figure, these officials saw what was coming, and before the war ended they began belaboring the Indian Office in Washington with prophecies of what would happen when this third false prosperity ended. They were not believed.

The war ended, the men came home, once more it was hard to get work off the reservation. The money was spent. Then the situation that had been building up for decades was fully revealed. As the Navajo country now stands, and in view of the primitive condition of the Navajos themselves, not half of them can wring a bare subsistence from the land. For the remainder, there is only irregular labor of the most undesirable sort to stave off outright starvation. The population continues to increase, despite the



▲ AT NINE YEARS of age, this girl has mastered the art of making delicious fried bread



▲ FAMILY SCENE in the hogan, which is built of peeled logs. Mother is combing daughter's hair with yucca fibers

highest infant mortality rate and tuberculosis death rate in the country, because the people are still prolific. With the weakening of chronic hunger, however, they may diminish.

The Navajos themselves have learned their lesson. They now set universal education above everything else, and for several years, without result, have been pleading with Congress for schools and teachers that will fulfill the terms of their treaty.

In the fall of 1947, the full measure of Navajo destitution became apparent when it was necessary for the Red Cross and private individuals to rush to their relief until Congress could make an appropriation for that purpose. The Office of Indian Affairs and the Department of the Interior woke up. At last they accepted the representations of the Navajo Service and took up the rehabilitation plan it had developed in consultation with the Tribal Council.

After further consultation with various lay organizations working for Indian welfare and advancement, this plan was developed into legislation and introduced in the present session of Congress. It would set up a program extending over ten years for a major development of many thousands of acres of potentially irrigable lands, the full development of other resources such as coal and timber, a sorely needed network of roads, adequate hospitals, a vastly expanded school system, a strong employment and placement service. To the maximum possible degree all work would be done by the Navajos, who would receive on-the-job training and elementary instruction in English and literacy such as was developed by the military during the war. A thousand or so families would be resettled on extremely fertile, idle lands of the Mojaves' Colorado River Reservation on the Arizona-California border. The Navajos would be encouraged and assisted in setting up the industries which, with increasing education, they could profitably manage.

The program, which might cost as high as \$150,000,000, would in

itself carry the Navajos for ten years. At the end of that time it would have most of them established on a firm economic basis, with a large number trained in skilled and semiskilled work and ready to compete for good jobs outside. From then on, the adequate educational system would have to take over, producing graduates equipped to make their way in the great world or on the reservation with new enterprises not dependent upon the soil. Most authorities agree that the plan is sound and effective, and that for all its cost, it would be a long-range economy for the nation.

The Bureau of the Budget took a long time before it approved the legislation. The bill reached Congress in April. Hearings were held. Testimony was overwhelmingly in favor of the plan. Yet no action was taken, and the Navajos must survive on the hope that the next Congress will listen to their pleas.

The Navajos do not want to live on relief. They want to support themselves. They are proud, they want to remain Navajos, and as Navajos they want to have true equality with their fellow citizens. They are ready to adapt themselves again, to take into the basic, free pattern of their life new elements of profound change. They can do it and still retain their fundamental values. They will become less picturesque from the point of view of the casual tourist, but to the anthropologist there will be fascination in the adaptations and selections they will make.

Without help they cannot select. Misery and sickness are causing their culture to degenerate. Family ties break down. Migratory labor undermines morale and morals. The attitude towards religion grows apathetic, while some in desperation turn to the drug-induced escape of the peyote cult, which is spreading among them. They will not die out, but they can become an utterly wretched group of disheartened paupers. For 80 years we have had them in our charge—a most hopeful and promising people—and this is our achievement to date.



▲ MOVIE-GOERS are familiar with the picturesque homeland of the Navajos but with temporary embellishments. This is a ghost town that sprang up when it was decided that Monument Valley would be a fitting setting for "My Darling Clementine"



➤ SOME of the better educated Navajos can compete in a white man's world, but for most of them there is only temporary relief from poverty and the lowliest forms of labor



▲ INSIDE THE TRADING POST: Navajos purchasing groceries with the meager earnings from their blankets and handmade jewelry. Will the Navajos be given the necessary assistance to take their rightful place in the world? It is for the American people to say



# The FIERY Serpent

By JOSEPH BERNSTEIN

LONG ago a certain worm made such an unusual nuisance of itself that it achieved undying notoriety by having its exploits described in the Bible. While the Israelites were wandering in the wilderness near the Red Sea, "fiery serpents" suddenly began attacking them, killing off great numbers of people. A creature that some have thought to be this fabulous "fiery serpent" is in existence today and is still a major scourge from India to Arabia. But modern science knows it as a parasitic roundworm rather than a serpent. It is called *Dracunculus medinensis* or, more commonly, the Guinea worm.

Only a fraction of an inch in diameter and milky white in color,

Notorious of old, the four-foot Guinea worm gives birth by an amazing "automatic sprinkler system"; but the peoples of arid sections of Asia and Africa can eliminate this pest by simple sanitary measures

it may reach the fantastic length of four feet. If you ever see a Guinea worm, the chances are that it will be a female, for the much smaller male is practically unknown.

Visitors to the village markets in certain parts of Arabia, India, and various communities near the desert in Asia and Africa have frequently observed a strange scene that is almost as ancient as the desert itself. Seated before an elderly medicine man or other local "doctor" is an immobile man, woman, or child, next to whose arm, leg, shoulder, or back the native physician, profoundly absorbed in his work, is carefully winding a stick. Tightly wound on this stick is what appears to be a white thread, which is being slowly pulled out of the patient's body. This cord, of course, is a Guinea worm, and the fine art of separating it from its victim is one of the most time-honored rites in the medicine man's bag of tricks and one which has been handed down unchanged through the generations.

The victim becomes infected with the Guinea worm by drinking water containing tiny water fleas harboring the worm's larvae.

The Guinea worm's favorite habitat is the connective tissue directly underneath the skin on parts of the body most likely to come in frequent contact with water. Why it restricts itself so fastidiously to such specific areas we shall presently see. Man is not the only host that harbors this worm: *Dracunculus* frequently bestows its unwelcome attention on dogs, jackals, leopards, cattle, horses, and baboons. Even cobras have not been spared.

When a female worm becomes mature, she is literally a reproductive machine highly adapted to the production of vast quantities of young. If the body cavity of such a worm is opened, it will be seen that it has practically no digestive tract. Everything below the esophagus has become greatly reduced in size, and in its place is an exceedingly long uterus packed full of actively moving larvae. For the Guinea worm gives birth to its young alive.

When ready to release her larvae to the outside world, she migrates to the skin. And here we at last discover the reason for selecting areas of the body most likely to be exposed to water. The motile larvae need a medium in which they can swim, and they thrive best in cold water, such as is found at the river's brink or in wells. Parasitologists had long been aware of certain peculiarities in the distribution of this worm in the bodies of male and female natives. Women seemed to have the worms most frequently in their arms and legs, while in certain communities, men and boys were most often parasitized in their backs. And in India, the worms seemed to exercise an unusual preference for the legs.

When the reason for this selection of special areas of the body



Photograph by Maché

▲ ADULT GUINEA WORM beneath the skin of the chest and abdomen. A dash of cold water causes it to spray out living young



for infestation was finally discovered, it flabbergasted the worm experts. They had never suspected that this lowly worm could have adapted itself so well to the habits of its victims.

In the parts of the world where the Guinea worm thrives, women almost universally wash clothes while standing in the water barelegged and bare-armed, thus providing ready avenues of escape for the larvae. To the boys and men falls the arduous task of lugging water back to their homes from an often distant site, and the bare backs of such water carriers become convenient avenues of escape for the larvae, since these parts are constantly in contact with spilling water.

The situation in India, where parasitization is unusually heavy, is unique. In this country are to be found the so-called "step wells." These are approached through graded steps covered with water, and as the people stand barelegged and often knee-deep on these steps, they give the Guinea worm larvae a wonderful opportunity to escape into cold water.

But let's get back to the female Guinea worm living near the surface of the skin. She is confronted with an overwhelmingly difficult problem in providing for the survival of the next generation. Consider for a moment what she is up against. The areas of the world where this worm is found are generally arid. Yet without water for the swimming larvae, the worm's

life cycle cannot be completed. A mechanism therefore had to be perfected for getting the larvae in contact with this precious fluid at every opportunity. In the Guinea worm's almost waterless domain, such chances are few and far between. Not a single chance of exposure to water could be missed.

The fantastic way *Dracunculus* solved this problem has awed naturalists hardened to the most fabulous adaptive devices of living organisms. Beneath the flesh of her host, the Guinea worm pierces the skin with the head end of her body, forming an ulcer about the size of a dime. At the base of this wound is a minute aperture, against which the worm's uterus is pressed.

The very moment there is even the slightest exposure of this ulcer to cold water, a milky fluid containing thousands of larvae spurts out from the sore's orifice. Parasitologists who have observed this process experimentally by squirting water on the ulcers have attested to the split-second timing of this reaction. The worm is, of course, reacting automatically to a stimulus, and we cannot impute thought processes to such a lowly creature; but the effect is the same as if the worm realized that not a moment of the rare opportunity to perpetuate the species must be wasted.

After each discharge, the part of the uterus in the center of the ulcer dries up, thus closing in the rest of the larvae, which cannot escape until the ulcer is next splashed with water.

But why is it so essential for the larvae to find their way into water? Why must they be able to swim instead of developing on dry land? The reason is that before reaching maturity they must first pass through an intermediate stage of development inside an aquatic organism. This intermediate host is a small and universally common organism, *Cyclops*, otherwise known as the water flea.

The special need for just this organism is shrouded in the mystery of the early evolution of the Guinea worm. Back in the dim past the conditions of life were drastically different for the worm from what they are today. It is presumed that the water-dwelling host was once the final host and that the worm adopted horses, baboons, dogs, human beings, and others after these creatures had evolved. Like a strange relic from the ancient days of its origin, the worm's watery phase of life has remained to this day, even though it is a constant hazard to the existence of the species. But the die has seemingly been cast. Unless a profound evolutionary change takes place, the Guinea worm will never completely emancipate itself from the water.

After swimming around for about two or three weeks, the larvae bore into the bodies of water fleas, where they undergo various transformations. After from four to six weeks, they are ready to infect their next victims—humans and other animals.

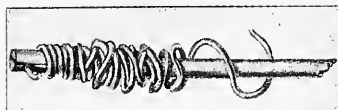
And man himself obligingly helps complete this last stage of the life

▼ GUINEA WORM under skin of arm. Removal is one of medicine man's oldest tricks

From Manson's Tropical Diseases



THE FIERY SERPENT



From Greene's Medical Diagnosis

▲ GRADUAL EXTRACTION is achieved by rolling the worm on a stick—today as centuries ago

➤ THE TIME-HONORED RITE: removal of the Guinea worm as depicted in the seventeenth century

After Velschius, 1674



cycle by imbibing water containing infected water fleas. For wherever the Guinea worm abounds, man is notoriously indifferent to the purity of his water supplies. In India, where *Dracunculus* is strongly entrenched, many people think nothing about drinking water from step wells in which their infected neighbors have been sloshing around with their bare legs. This is what their ancestors did from time immemorial, and the old ways are still good enough for them. The Guinea worm takes advantage of this habit.

After *Dracunculus* reaches the digestive tract of her human host through being swallowed with water, she lives in the deeper tissues and is not at once visible beneath the skin. After about a year, she moves toward the surface of the body in order to discharge her young. From now on, she will have

only one mission in life: to eject her larvae to the outside world with each contact with water, until her supply of young is completely exhausted. Only at this point does the worm, its birth-giving labors completed, at last shrivel up entirely and die. Its body calcifies and can be felt for years in the skin of its human host as a hard, twisted cord.

If the worm is left alone in the body, it may never cause serious trouble. But it is an irritating nuisance, and in a tropical climate such a constant annoyance may drive one frantic. Little wonder that few natives are content to let *Dracunculus* alone but instead start pulling it out. And here is where the danger arises. Should the body of the worm break during efforts to extract it, the larvae pour into the surrounding tissues, spreading infection in their wake. This causes

the high fever and blood poisoning that is such a frequent cause of death. So, if this be the "fiery serpent of old," it is not without reason that the Israelites gave it such an awesome name.

One effective way of extracting a Guinea worm without the danger of breaking it is to kill it with an injection of an extremely dilute solution of mercuric chloride. The dead worm can then be removed from its host's tissues with ease. This, it might be added, is probably the first major change, throughout the ages, in the manner of coping with a Guinea worm.

But even this modern technique is not the final answer to the Guinea worm problem, particularly in certain sections of India where infestation may reach plague proportions. The solution must inevitably lie in the development of strict sanitation measures to prevent parasitized humans from polluting water used for drinking purposes. One practical way of achieving this end, which has long been urged by authorities on the subject, is to outlaw the step wells that daily launch inconceivable numbers of worm larvae on their infective careers. Accompanying this must be a patient program to teach people in the affected areas to drink only filtered or boiled water. And in spite of the intractable ways of human beings when urged to adopt new habits, wonders have been achieved in this respect. So perhaps the Guinea worm, man's unwelcome companion almost from his beginnings on earth, may yet be conquered.

Perhaps you may have been wondering, "Is the Guinea worm limited only to hot, desert areas? Are there such worms in America? And if there are not, is there danger of their getting a start here?"

At present, *Dracunculus* has been able to establish a foothold only in Brazil and the West Indies, where it was introduced from its native haunts in Africa during the slave-traffic days. It is not known to exist on the North American continent, and it is highly unlikely that it will ever appear in the foreseeable future.

## HEREBY HANG SOME TAILS

By EDWARD DEMBITZ

You undoubtedly recognize many animals by their heads. Can you identify these by their tails? Nine right is an average score.

### Whose tail.....?

1. Broad and flat, is used both as a rudder and to produce warning signals but never as a trowel.
2. Is used as a support when the animal rests on its hind legs.
3. When spread, is shaped like a musical instrument.
4. Is longer than the body at birth but completely disappears when adult form is reached.
5. Is covered with barbed quills, first waves defiantly and then strikes if its owner is attacked.
6. Supports a train of iridescent plumes, which are spread into a beautiful fan during courting periods.
7. Segmented, bears a venomous sting at the tip.
8. Held erect in running, displays the prominent white underside from which the animal derives its name.
9. Is used by the mother to tow her cub to safety when danger threatens.
10. When severed can be reproduced.
11. Slender and whiplike, is armed with a single dangerous spine equipped with barbs.
12. Produces a warning noise when the animal is about to strike its victim.
13. Is used for grasping objects under water but belongs to a creature whose head gives it the name of a common domestic animal.
14. Nonexistent or very rudimentary, its lack distinguishes this animal (which was named after an island) from its familiar and common relatives.

Answers on page 333

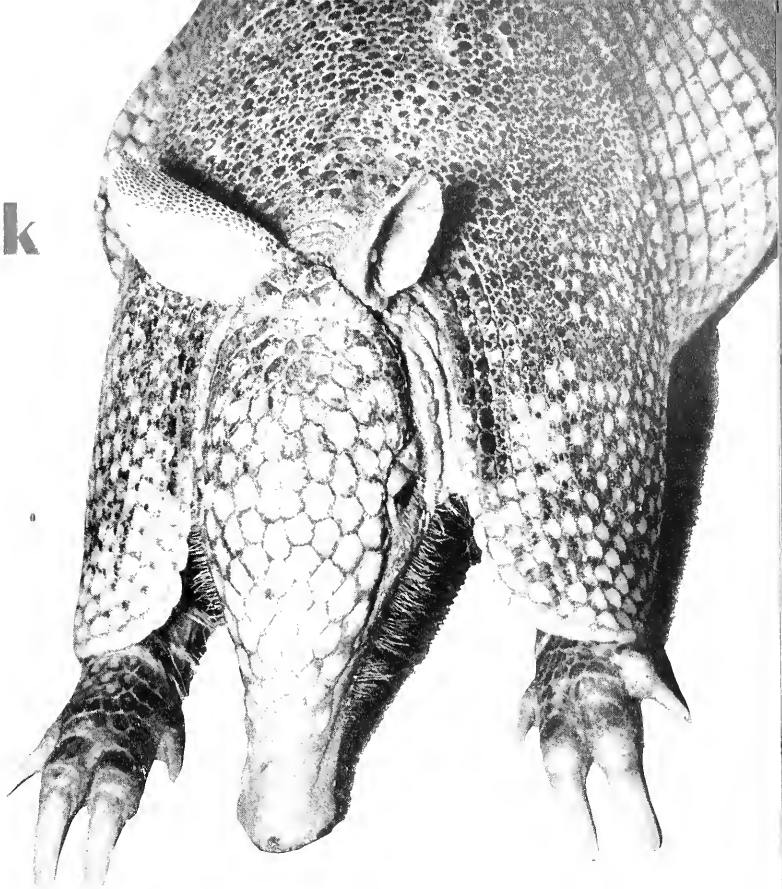
# Nature's Little Tank

By KARL H. MASLOWSKI

*Photographs by the author*

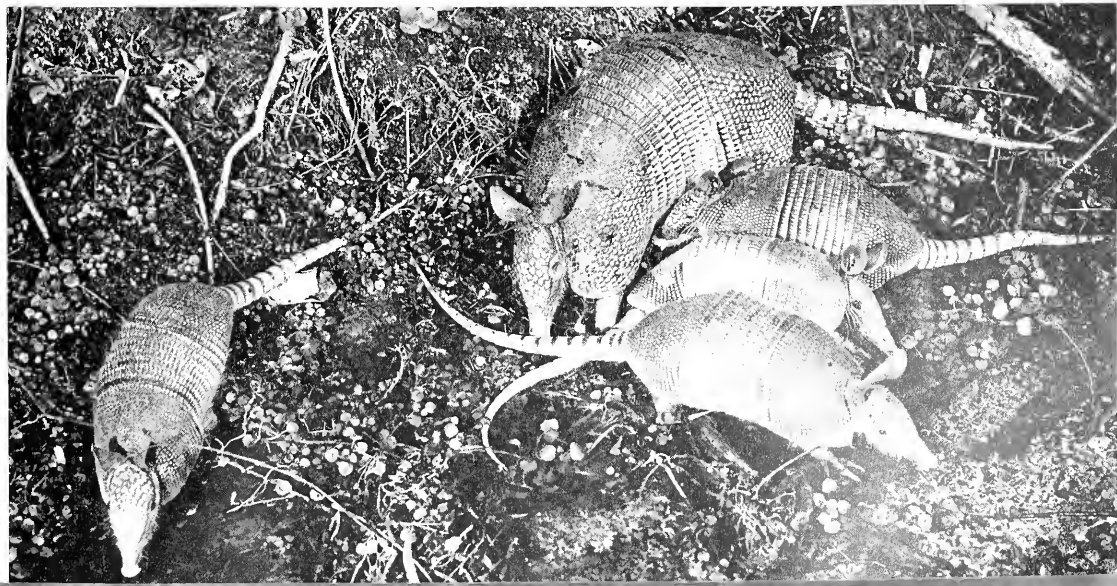
THE Nine-banded Armadillo would be a leading contender in a contest to determine which is the world's strangest animal. This North American species would compete with such foreign oddities as the Duck-billed Platypus, the Pangolin, and the Echidna.

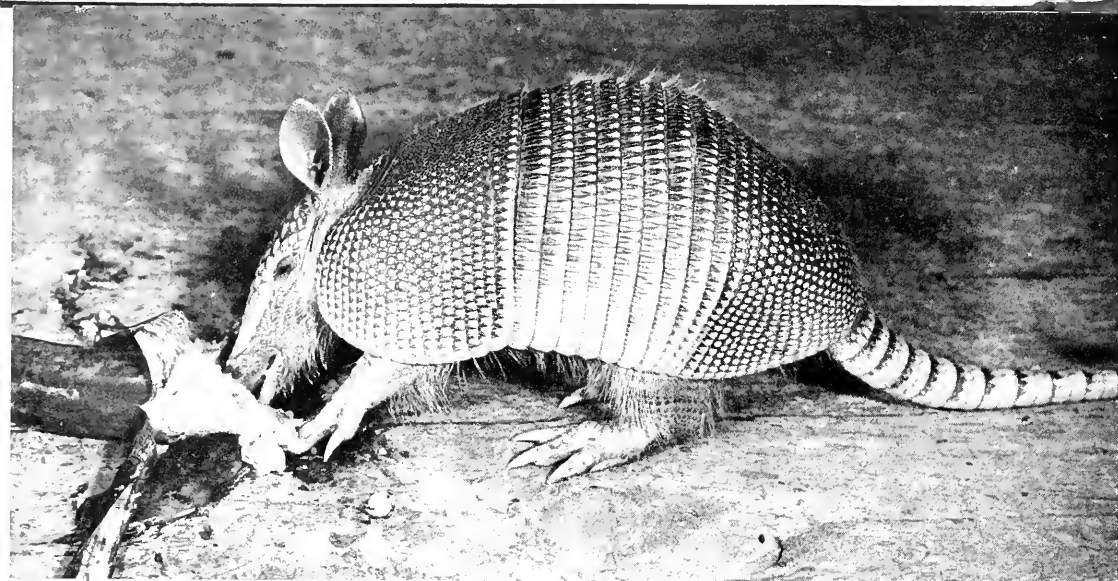
Within the past 100 years, the armadillo has extended its range from Mexico many hundreds of miles into Texas and Louisiana. As late as 1880, it was found only in the extreme tip of southern Texas, but today it has pushed northward almost to the border of Oklahoma, westward to New Mexico, and eastward to the Mississippi River in Louisiana.



▼ A MOTHER ARMADILLO and her litter of four young, nosing about for insects and earthworms at the edge of a spring near Salado, Texas. The embryology of the nine-banded armadillo is unique among North American mammals, for a normal birth always consists of quadruplets of the same sex

▲ A HEAD-ON VIEW of an armadillo is reminiscent of a knight in armor. The front feet are armed with four toes. The center toes are equipped with curved claws that are well suited for digging, and they can inflict serious injury to an attacker





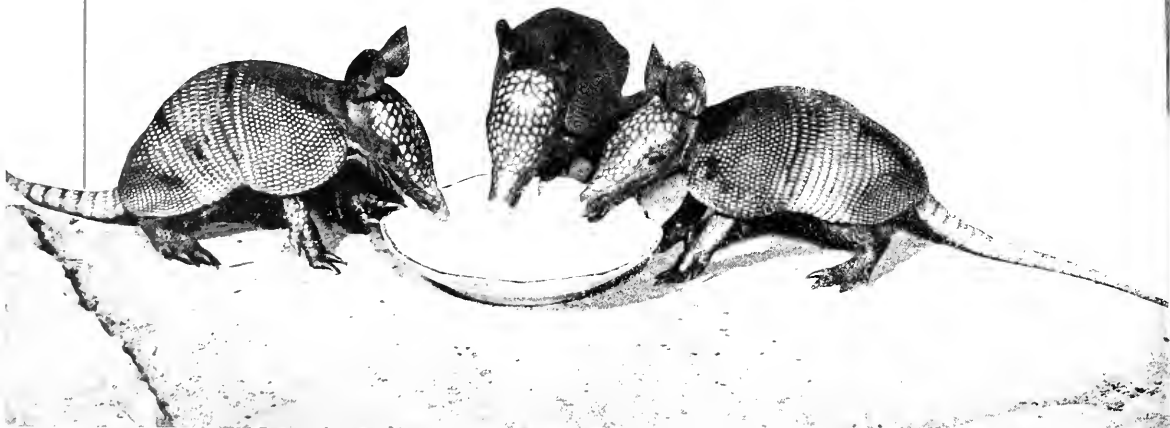
▲ ARMADILLOS are particularly fond of well-ripened bananas and grapes. Their teeth, all molars, are among the most primitive found in mammals

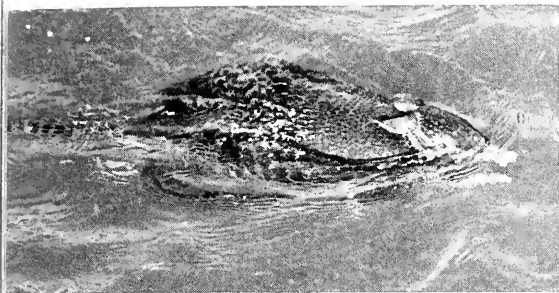
THE DIET of armadillos has been thoroughly investigated, and some 488 specifically different items have been identified in the animal's bill of fare. Included are berries, spiders, worms, beetles, eggs, pine needles, and ants



▼ THESE three babies have a saucerful of milk on an armadillo farm

▲ DEMONSTRATING how *not* to try to pull an armadillo from a hole. The animal anchors itself so securely to the inside of the burrow with its forepaws and body plates that it is well-nigh impossible for a man to pull one out





THE ARMADILLO'S PHENOMENAL SPREAD into southern United States is all the more amazing when it is remembered that it has to cross rivers and that it is heavier than water. Its specific gravity is about 1.06. The heavy shell and bone structure would ordinarily cause the creature to sink, but by ingesting air into its intestinal tract it can puff itself up like a balloon and keep afloat.

➤ AN ARMADILLO intercepted while swimming with its intestines filled with air (*left*), compared with one under normal conditions (*right*)



IF YOU REACH under the creature's "shell" and tickle its "tummy" as shown in this picture, the animal relaxes immediately and . . .

. . . may be lifted from the burrow without effort. Armadillos are most active at night, retiring to burrows during daytime.







▲ THE GREAT, WHITE TRUMPETER SWAN, North America's largest wild fowl. The trumpeter once seemed doomed to extinction, but strict enforcement

of conservation measures is aiding its fight for survival. Wingspread of the male (left) is almost ten feet. A telephoto picture taken in a northern Alberta slough

# Return of the Trumpeter

MY interest in the trumpeter swan dated from a trip to the salt swamps of Andros Island in the Bahamas to photograph the roseate flamingo.<sup>1</sup> There, plagued by the scorching sun and legions of tropical insects, I read in my bird texts that photographs of the trumpeter swan were nearly nonexistent. As all bird lovers know, this great white swan—the largest of North American wild fowl—has been perilously near extinction.

A check of the Audubon Society's photographic files supported the statements of the bird scientists. Among thousands of photographs (one of the world's finest collections), there was but a single picture of trumpeters—an immature pair showing the brown primaries and flesh-colored bill characteristic

At last, a "personal interview" with the largest of North American wild fowl—a little-known bird that might have slipped into oblivion but for the labor of conservationists

By DUANE FEATHERSTONHAUGH

*All photographs by the author*

of the first summer. Then I went to the New York State Museum at Albany and saw the trumpeter in a case with the great auk, the passenger pigeon, the Labrador duck, and the Carolina parakeet. A sign beneath the case read, "Five birds you may never see again."<sup>2</sup>

Our purpose was not only to try to get pictures of the bird but to see whether anything further could be done to protect it. Permission

to make the studies was granted by Dr. Harrison F. Lewis, Chief of Canada's Dominion Wildlife Service. Arrangements were completed through the co-operation of J. Dewey Soper, Dominion Wildlife Officer for the Prairie Provinces, and Sergeant H. G. Wickstrom, of the Grande Prairie Detachment of the Royal Canadian Mounted Police. William H. Bloodworth and A. B. Wellborn, both experienced wildlife photographers, completed the personnel of the expedition.

<sup>1</sup>See "The Flamingos of Andros," *NATURAL HISTORY Magazine* for January, 1947.

<sup>2</sup>Since the expedition, the trumpeter swan has been removed from this exhibit.



For a bird that seemed doomed to oblivion two decades ago, the trumpeter swan gave us a very decent reception. After the 3700-mile automobile trip from New York to the Grande Prairie area of northern Alberta, it was only a few hours before we had found our first swan's nest. This was late in May. Before we returned 8 weeks later we had located 41 nests. We also counted twelve pairs of nonnesting swans, all immature birds. However, because nonbreeders, unlike the nesting birds, frequently fly from one lake to another, one pair could have been counted more than once.

We feared there would be difficulty in approaching the birds and in distinguishing them from the whistling swan. Neither problem arose. The swans in the Grande Prairie area frequently nest close to dwellings and are accustomed to the sight of people, and there are no whistling swans in the area.

We were astonished to find that many published statements regarding the swans were wholly or partially incorrect. This probably can be attributed to the former wariness of the bird in the Grande Prairie area and in less settled areas today. Strict enforcement of conservation measures has caused it to become "tamer" in the more populated areas, and many times the birds allowed us to approach within a few yards. Telephoto equipment permitted extreme close-ups.

One difficulty was with flight pictures. The trumpeter has a strong and sustained flight, but it rarely takes to the air during the breeding period. Also, it is incapable of flight for some days after molting its primaries late in June. Even when able to fly, it will swim away when danger threatens, taking to the air only if definitely being overtaken on the water.

The trumpeter swan (*Cygnus buccinator*) is a massive bird with an average length of 65 inches and an 8- to 10-foot wingspread. It weighs 30 to 35 pounds. It differs from the smaller whistling swan—a bird about 55 inches long—chiefly in the construction of the windpipe

RETURN OF THE TRUMPETER



▲ A YEAR-OLD TRUMPETER in position for attack

and sternum, and in the call. This is a clear, deep honk, similar to a French horn in quality and resonance. While the call is not particularly loud, it carries a great distance. Our camp was more than a mile from the nearest nest, yet we could hear the swans trumpeting to each other as we watched them swim about the lake. This observation, incidentally, disagrees with statements that the swan does

not trumpet while on the water.

The National Audubon Society estimates that about 1500 of these magnificent birds remain. Most of them breed in the interior of western Canada and migrate westward to winter in the milder coastal areas of southeastern Alaska and British Columbia. There is a smaller concentration of them in the Red Rock Lake-Yellowstone Park area. These are nonmigratory.

▼ ACCUSTOMED to the sight of people, the trumpeters in the Grande Prairie region of Alberta would allow a boat or person to approach near enough to take close-up photographs with standard telephoto equipment



Apparently the habits of the birds differ at the various breeding places. Those at Grande Prairie would allow a person or a boat to approach quite closely. But Ward M. Sharp, Manager of the Red Rock Lakes Refuge, wrote to me that "Here there is an entirely different problem. The incubating swan leaves the nest as soon as a boat is sighted and will not go near the nest until the boat has left the lake. I also note that they will hide their cygnets or abandon them when approached by a boat. The cygnets then scatter widely but are always later gathered together."

Trumpeter swans are apparently sometimes seen with whistling swans during the migration period of the latter. This adds to the difficulty of identifying the birds. There are several seemingly reliable reports of trumpeters and whistlers arriving together in the spring at Bear Lake, near Grande Prairie. After lingering on the lake for a day or two, the whistlers continue north while the trumpeters select nesting sites in the immediate area.

Ken Anderson, a rancher who lives on a hill overlooking Bear Lake, says he has several times seen the lake "white with swans."

Flights such as these, in which the majority of the birds were whistlers, may account for the reports of the great abundance of trumpeters years ago. Many authorities today doubt that the species was ever particularly numerous.

After spotting our first nest, which was in full view of the Grande Prairie-Peace River Highway, we went to the ranch of a Joe Tomshak. Dr. Lewis had written me that Tomshak knew where there were two swans. It was an understatement! The swans had made themselves at home on a small slough about 50 feet from Tomshak's kitchen door, and he couldn't get rid of them!

Tomshak, with the permission of the Dominion Wildlife Service and the RCMP, had rescued four cygnets the previous fall when Ferguson Lake had dried up. He left two others with the parent swans, afraid that if he took all the young, the adult birds would not return to the nest the following year. The two cygnets he left with the parents were later found dead about half a mile from the lake. The parent swans apparently had attempted to lead them overland to Clairmont Lake, two miles away.

Two of Tomshak's cygnets were later shipped to the Edmonton Zoo by the Canadian Government. The rancher was allowed to keep the other two on the condition that he release them in the spring. He did so, and the birds promptly made themselves at home on the slough. When we saw them, they were as tame as domestic fowl. They would waddle up to the kitchen door to beg for bread and drink from the rain barrel. They seemed to have a grudge against the hired man, and whenever he ventured near the slough both swans would turn on him.

Canadian bird lovers have urged the Dominion Wildlife Service to allow the birds to remain there, in the hope that they are male and female and will breed on a small island in the slough. The author also recommends this strongly. There is much to learn of the breeding habits of the trumpeter, and here is an opportunity that may never come again.

The two swans had the typical brownish tinge on the neck and primary feathers of first-year birds. As nearly as we could measure while coaxing them with feed or attempting to hold them, they were



▲ A TRUMPETER SWAN taking off from the water. After carefully ascertaining wind direction, the bird runs across the water until it has gained flying speed, then pulls up its legs to become air-borne



▲ WHEN POSSIBLE, the swans prefer to take off from land. This one is running across marshy ground near a northern Alberta lake

about 60 inches in length, with a wingspread slightly over 8 feet. They could get their  $4\frac{1}{2}$ -inch bills over the edge of the rain barrel, which stood 41 $\frac{1}{2}$  inches high. Because of their "easy" life on the ranch, they appeared considerably heavier than the wild swans we were to study later. Forty pounds would be a fair estimate of their weight.

The two swans trumpeted fre-

they would swim about the slough testing the wind direction. If this satisfied them, they would swim to the downwind end of the slough, trumpet a few more times, and begin their take-off.

The take-off reminded us of an overburdened seaplane. The swans started swimming into the wind, flapping their wings. Within 50 feet they gained sufficient speed to be running over the surface of the

the sunlight, could be seen for several miles. Even at a distance they gave an impression of size.

In landing, the birds would circle the slough, again judging wind direction. Then they would fly far enough away to hit the very beginning of the water on the downwind side and land into the wind. They braked with their wings until they were able to let their legs down and slow to a stop by running over the water for a short distance. The distance required was much less than for the take-off.

The birds seem to prefer taking off from land, and many times they waddled several hundred feet to a wheat field and took flight from there. The run was about the same as that on the water, but it was done more easily. We did not once see the swans attempt to take off across wind or down wind. The adult birds seldom flew, whereas the immature, nonnesting swans were frequently observed soaring over the lakes.

At this point we did not realize that the wild swans were almost as "tame" as those at Tomshak's. Certain statements in Arthur C. Bent's *Life Histories of North American Wildfowl* and the National Geographic Society's *The Book of Birds* (Vol. 1) had led us to believe we would be fortunate to secure pictures without the use of blinds and telephoto and remote control camera equipment.

We set up camp on a high spot between two lakes, where we could watch both bodies of water. We were about to leave to visit the nest we had seen from the highway when we heard trumpeting from the direction of the other lake. A swan stood out snowy white on the blue water. It was feeding quietly with no suspicion of danger, and we suspected the honking to be a signal to its mate. A few minutes later, with the field glasses we located the head of a second swan sticking above a stand of bulrushes, approximately in the middle of the lake.

"Must be the female on the nest," Bloodworth said.

It was so obvious no agreement was needed.



▲ THE TRUMPETER is difficult to photograph in flight. The mature birds rarely fly during the nesting season, preferring to swim away from danger

quently as they swam gracefully about the slough. We fed and chased them to observe their reactions and soon found that the position of the neck told their mood. When the trumpeter is relaxed and at ease, it holds its neck in a graceful curve. At the slightest sign of danger, the neck is held straight up, sharply and stiffly. From a distance this makes it appear that the bird has sunk lower in the water, which is not the case. When the swan is angry the neck is sharply bent, with the head down.

It was easy to guess when the birds were about to fly. First they would pump their necks up and down for several minutes, trumpeting loudly at the same time. Then

water. Then they redoubled their flapping and finally pulled up their legs to become air-borne. Like good pilots, they then leveled off to gain flying speed and finally pulled up sharply. Depending on the headwind, the entire take-off took a run of 200 to 300 feet, which may explain why the swans fly no more than necessary.

Tomshak's swans had more difficulty rising than the wild ones, probably because of their weight. Those in the wild state, we observed later, usually became air-borne after 100 or 150 feet.

Once in the air, the swans reminded me of a cross between a small airplane and a pterodactyl. The great white wings, flashing in



◀ NEST AND EGGS of the trumpeter swan being checked by N. E. Goodfellow, of the Royal Canadian Mounted Police. This nest had only five eggs (the fifth is hidden here)—the smallest number found in any nest

▼ HATCHING OF A TRUMPETER: a scene perhaps never before photographed. The first cygnet has gained sufficient strength to sit erect. The hatching cygnet has succeeded in working its head and bill through the egg and has managed to shove its foot between its head and the shell. It used its foot as a lever to work the rest of the body out



We still thought it would be necessary to set up a blind but decided to wade into the lake and look the situation over. We took our cameras—just in case.

The female, who kept a constant watch in all directions, spotted us before we were ten feet from shore—and the nest was still half a mile away. She trumpeted loudly to her mate. He began to swim slowly toward the nest, still feeding but keeping an eye on the intruders.

The water was chest deep and icy cold. The footing was alternately a mass of tangled, decayed rushes and glue-like mud. Only Wellborn had bothered with waders, but these proved more of a handicap than a help, because he was soon beyond their depth.

Despite our attempts to hide behind patches of rushes, the swans kept us in view. The male was now beside the nest. The two honked from time to time but gave no other indications of alarm.

It was almost an hour before we came to the last stretch of open water separating us from the nest.

There were no more rushes to use as hiding places. We plunged straight across.

The swans watched curiously as the distance narrowed. At about 50 yards the male began to swim quietly toward the open water at our left. At 40 yards the female slipped off the nest into the surrounding bulrushes. At 30 yards there was a flurry of lesser scaups from the rushes. A redwing scolded us.

The nest was farther in the patch than we thought. We stumbled and pushed our way through. Suddenly we came to an open spot, possibly 30 feet across. In the center was a huge mound. It was about eight feet across and looked much like a beaver house except that there was a depression about two feet across on the top. In it were eight tannish-white eggs. Each egg was about four and one-half inches in length.

The mound was made of bulrushes and the depression lined with leaves, moss, a small amount of down, and a few feathers. Numerous small spiders crawled over

the nest. We were never able to explain the presence of the spiders. We found them on almost every nest we visited, yet we never noticed them about the rushes in the vicinity of the nests.

We photographed the nest and eggs, both in color and black-and-white, and then started to look for a suitable place for a blind. Suddenly there was a trumpet right behind us. We turned to see the two swans swimming toward us.

At first we thought they were going to attack. They came within 100 feet, turned, and swam a short distance to our left. They continued honking to each other as though discussing the situation and then did an about-face and swam toward our right. They kept this up for several minutes while we used our telephoto equipment to get several close-ups.

"Let's try it without a blind for a few days," I suggested. "They seem pretty tame, and they might get used to us."

The others agreed, and we started back toward camp. The



▲ AWARE of the approach of the photographer, the male trumpeter honks a warning. It had been supposed that the birds did not trumpet while on the water. These are immature birds

swans moved only a short distance to one side as we left the nest, although they continued to trumpet. By the time we had gone a quarter of a mile, the female was back on her eggs and the male was quietly feeding. Our visit had not disturbed them.

On the following three days, they gradually became tamer. The 40 yards shrank to 35, then 30, then 25, then 20.

At first we were careful to visit the nest only on warm days. The female left the nest during the heat of the day to feed, relying upon the sun to keep the eggs at incubating temperature. One day when there was a sudden drop in temperature as we waded out, we noticed unusual activity on the part of the female before she left the nest. When we reached it, we noticed that she had covered her eggs with rushes to preserve the heat. Later we found that the female also covers the eggs on extremely hot, clear days to keep them from getting too warm.

Meanwhile, we were busy locating nests on other lakes and photographing them. The largest num-

ber on one lake was five. In all, we found nesting swans on seven lakes and on a score of unnamed sloughs. One pair of swans had even built a nest on a slough just behind the Grande Prairie Airport, a principal stop on the Alaska-Edmonton run. The roar of the four-engine planes went unnoticed by the birds.

The smallest number of eggs in any of these nests was five and the largest eight. Seven or eight were the usual number.

Adult swans apparently return to the same nest year after year. On the smaller lakes and sloughs there will be but one nest, and should another pair of swans attempt to build a nest, or even to feed, on the same body of water, the nesting birds will drive them away. On the larger lakes, swans will build about a half a mile apart. Under these circumstances, each pair of swans seems to respect the "territorial rights" of the other birds.

The swans also drive off any geese that may land in the vicinity of a nest, but they pay no attention to ducks or other marsh birds. We found nests of the mallard, the

ruddy duck, the lesser scaup, and the American coot within a few feet of swans' nests.

The redwing blackbird also frequently nests near the trumpeters. The scrappy redwing, however, turns the tables. If the swan approaches its nest too closely it drives the larger bird away, circling its head and diving in for lightning-like pecks which the swan cannot counter.

Nonbreeding swans sometimes have a problem finding a place to feed. The moment they land within a half-mile or so of a nest, they are immediately driven off by the male breeder. They seldom resist. Once a pair of immature swans finds a spot where they are not molested by the breeding swans, they remain for the season. It seems probable that they use the spot as a nesting site in future years.

Trumpeters do not attain their pure white plumage until late in their second year. The brownish primaries are molted in late June or July of the year after their birth. The neck feathers follow, leaving only the brownish patch on the top of the head, which is retained for life.

We observed pure white non-breeders as early as May, which would indicate that the birds were at least two years old and still not nesting. Apparently reliable observers told me that they had seen white nonbreeders in the same spot for three or four years. These facts would indicate that the trumpeter does not breed until its fourth or fifth year, although it apparently mates during the second year. This would be consistent with the bird's life span of approximately 70 years.

Both nesting and immature birds often come on land to feed. They are not particular about their diet, eating vegetation, seeds, grain, insects, snails, small reptiles, and quadrupeds. Grain fields fronting the lakes are among favored feeding spots.

The swans are especially fond of wild celery. As this plant is found in abundance in the Alberta lakes, it seems likely that the birds will continue to breed there. They pluck the celery from the lake bottom, and

after a pair of swans has been feeding in one spot for several days, the water will be dotted with the floating, uneaten tops.

After we had been in the Grande Prairie area for five weeks, we became increasingly anxious to locate some cygnets. We had not been able to find a definite statement on the incubation period and were getting discouraged, as time was running short. Then we met Albert Sims, a farmer who resided near Clairmont. Sims told us that years ago he had taken a swan's egg from a nest the day it had been laid and placed it under a goose. It hatched in 35 days, he said. If that were true, the cygnets should be out within two or three days.

Two mornings later there was an unusual clamor of trumpeting on Ferguson Lake. We trained our glasses on the lake. The mother swan was swimming in open water near the bulrushes, and behind her, in single file, followed five cygnets!

We grabbed our cameras and ran to the lake. The mother swan saw us but paid no particular attention. The male, which had been feeding at the other end of the lake, began to swim slowly toward his mate and young. Both adults were trumpeting.

The adult swans might attack us, we thought, to protect their young. But instead they swam into the rushes, calling for the young to follow. We could see the group about 25 yards away as we worked our way to the nest to see what had happened to the remaining three eggs.

When we reached the opening in the rushes we could see why the birds had neither attacked nor fled. They had molted their primaries. The nest and the water around it was literally white with the feathers averaging 15 inches in length.

Something was squirming on the nest. We made our way to it and found a pearl-gray cygnet, still wet. He was peeping in a high-pitched, squeaky voice and trying to work his way out of the depression that formed the nest. Each time, he would get almost all the way to the top and then tumble back into

the nest. After resting for a few minutes, he would try again, only to fall back.

An unhatched egg was beside him. There was no trace of the eighth egg, nor were there any shells of eggs that had already hatched.

As we set up our equipment to photograph the cygnet, the other egg stirred slightly, and a tiny opening appeared on the upper side. We were witnessing the hatching of a trumpeter swan! And we had camera equipment on hand to record it!

I could not help but think of Bent's statement, "We have never seen a downy young trumpeter," and of the days spent by Arthur A. Allen and P. P. Kellogg in securing a single photograph showing cygnets. Ours was just luck, of course. We had happened to be in exactly the right place at exactly the right time.

It took the little fellow about ten minutes to wiggle his bill through the opening in the egg. The moment it was out, he began to peep. The other cygnet, again halfway up the side of the bowl, turned the moment he heard the peep, lost his balance, and tumbled back into the nest. He seemed to sense what was happening and rubbed his bill against the emerging one.

A half hour later, the cygnet had his head out. Then, peeping all the time, he managed to force a foot out over his head, and this gave him sufficient leverage to pull his body through. He lay as though dead for at least ten minutes.

As we were photographing this scene, a chorus of peeps came from behind. We turned around to find that the other five cygnets had returned to the nest, possibly in response to the peeping of the smaller birds.

As we were anxious not to disturb the magnificent birds any more than necessary, we returned to our camp. We checked the other nests to determine how many eggs had hatched but did not bother with further photographs. It seemed unlikely we could better those we had.

On the average, only about one

egg in each nest failed to hatch. We did not have time to spend the entire summer checking on the mortality of the young birds. As they do not fly until about mid-September, this will have to be a future project.

During our entire photographic tour, we were making studies of the position of the trumpeter in Alberta to see if any further protective measures could be taken.

The threat of extinction has not completely passed, though it has been lessened by the strict enforcement of conservation measures. Increased public education regarding the bird's precarious position, and possibly a few additional provisions to the Migratory Bird Act, should eliminate the threat.

The bird is not molested by the inhabitants of the Grande Prairie area. In fact, they look upon the swans with real affection, and more than one rancher I questioned told me he would "turn in his own brother" if he caught him shooting at a swan.

Young boys shoot a few. We found one dead swan that had been shot through the head. It obviously was the mate of a lone female we found nesting at a near-by lake, listening in vain for an answer to her trumpets. The incident was reported to the RCMP. A year ago a railroad hand from another section of Canada shot one, thinking it a goose. Obviously he had never heard of the bird. But he was turned over to police by his co-workers and received the maximum fine.

A few swans are shot by mistake each hunting season. On the whole, however, this number is insignificant.

There is an indirect result of hunting, on the other hand, that is a highly important and serious threat to the birds. Shooting of other water fowl over the lakes where the swans breed is allowed at certain seasons of the year. Most of this hunting is by shotgun, and the tiny lead pellets settle to the bottom of the shallow lakes. Swans, feeding off the bottom, frequently swallow these pellets. They are ground up in the gizzard, and lead



poisoning and slow death results.

A report in the files of the Audubon Society shows the seriousness of this situation. During the winter of 1945-46, fourteen out of a flock of fifteen trumpeters wintering on a British Columbia lake died of this cause. How many trumpeters die similarly each year is not known, but the number must be considerable.

Lack of food on the wintering grounds also is an indirect cause of many deaths. The birds generally escape death by starvation, but sometimes they are so weakened that they are unable to defend

themselves against their natural enemies. Normally, a trumpeter can escape from a coyote or an eagle, or defeat it in combat. Weakened, they cannot. This problem has been met in part by feeding them barley, but it is often difficult to get the grain to remote lakes.

There are also a number of deaths each year from parasitism, but until suitable studies are made, no solution can be suggested. One difficulty is the problem of securing fresh carcasses and getting them to laboratories before decay has set in.

There were no superficial evidences of parasitism in the Grande Prairie area, but this means little, as the parasites may develop later in the season. Bird students in that area, however, say that they have seen no sick or "droopy" birds during the past few years, even late in the season. The parasites should not be an important factor during the winter season.

Another danger is that the shallow lakes of northern Alberta frequently dry up completely during the summer. The cygnets then are stranded and either die of exhaustion on the overland trek to another lake or fall prey to foxes and coyotes.

It would seem that many of these

conditions could be corrected. The prohibiting of all shooting over lakes where swans breed would lessen the danger from lead poisoning. But a more practical solution would be the use of nonpoisonous shot. There seems to be a good probability that this will become available, and the sporting public should be induced to use it.

A warden should be assigned to the Grande Prairie area to keep an eye on the swans. This could be a part-time position. One of the warden's most important services would be to rescue cygnets from lakes and sloughs that are in danger of drying up and to move them to still unstocked areas or force the surplus, if possible, to migrate.

In all other respects the position of the trumpeter swan in Alberta is extremely favorable. In general, the birds are not molested, summer feed is plentiful, and there are abundant nesting materials.

Ranchers and bird students alike agree that there has been a noticeable increase in the number of birds during the past three or four years. The 1948 hatch, unless something unusual occurs, would seem to assure an even further increase in another year.

The great, white trumpeter swan is returning.



ONE OF A PAIR OF CYGNETS rescued by Joe Tomshak from a dried-up lake. Tomshak entered the birds with the permission of Canada's Dominion Wildlife Service and leased them this past spring, but they could not leave. Note the swan's size compared with Tomshak, who is six feet tall

A PAIR OF IMMATURE TRUMPETERS, showing the slight tinge of brown on the primary feathers. The dark patch atop the head will remain. Swans mate for life during the second or third year, but apparently they do not breed until their fourth or possibly fifth year. They are said to reach the age of 70





◀THE THREE TURKEY HOUSE occupies a well protected position in a 300-foot canyon

▼ TREE-RING EXPERTS have determined the age of this rarely visited cliff dwelling to be almost 700 years

# The Three Turkey House

An ancient settlement in a remote section of Arizona

By JOHN HENRY COON  
*Photographs by the author*



THE Three Turkey House, which gets its name from a rock-picture of three turkeys on the wall of the house farthest in the cliff, is in northeastern Arizona, in a canyon some three miles south of the boundary of Canyon de Chelly National Monument. This canyon does not open into Canyon de Chelly. Its waters flow westward into the Naslini wash. It is about 300 feet deep at the Three Turkey House.

This cliff dwelling first became

known to archaeologists in 1938, when Dr. Harold S. Colton, of the Museum of Northern Arizona at Flagstaff, entered the ruin with a group from the Museum. To their surprise, they found a partially obliterated name which looked like "W. E. H.—1898." In another place the names of S. E. and C. L. Day, Dec. 16, 1900, were written. So Sam Day, a well-known character in the Navajo country who had a

way of getting around, was one of the first white men to enter the Three Turkey House.

From wooden beams in the ruin, tree-ring experts fix its date at between 1266 and 1276. There are some convincing indications that the cliff dwellers who built the Three Turkey House belonged to the Mesa Verde Culture and thus were of the same Indian tribe that lived on Mesa Verde, Colorado.

## LETTERS

*Continued from page 338*

partment of Birds at The American Museum of Natural History:

This account of the Baltimore Orioles feeding on nectar is very interesting. I am not sure that they were not obtaining insects rather than nectar, for I do not recall any absolutely positive observation of nectar-feeding by that species, al-

though it is, of course, a possibility. There are many other birds that are known to visit flowers for that purpose, and the orioles may easily belong in that category. They have been known to pull flowers to pieces, and it is quite possible that they may have been after the plant secretions.

There is no doubt whatever that the pollination of flowers by birds does occur. Many accounts of it are on record; in

fact, there is reason to believe that certain flowers from the tropical regions of both the Old and New Worlds can be effectively pollinated only by particular birds that visit them, and not at all by insects. The arrangement of pistils and stamens often may be such that the bird's head comes at just the right place while the creature is feeding, to receive the pollen from one flower or leave it in another. Some very interesting adapta-

tions exist showing a correlation between the shape of a corolla and that of the bill of the species of bird that visits it. Two outstanding examples may be mentioned. The Sword-billed Hummer has a bill over  $3\frac{1}{2}$  inches long, and it frequents flowers that are of similar depth. The Sickle-billed Hummer, on the other hand, whose bill is extremely curved (making about three-quarters of a semi-circle) visits flowers that have equally strongly curved corollas. Only birds with the proper kind of bill could possibly probe the flowers in question, although certain other species with short bills have been said to pierce the bases of flowers to get at the nectar.

There are records of certain kinds of tropical flowers that remain closed until subjected to the pressure of the mandibles of certain species of sunbirds (counterparts, though unrelated, of our American hummingbirds). This causes the flowers to open and give access to the concealed nectar, at the same time exposing the pistil and stamens for the necessary pollination. It is claimed that no insect could operate this mechanism. In this case, at least, the bird appears to be an absolutely essential aid in the life of the plant. In other instances, of course, as with your orioles, the bird's part may be useful but not necessarily requisite.

#### Alternate Leader

SIRS:

During the past warm October, while lying on the sand dunes along Lake Michigan, I watched the flocks of ducks migrating. In one flock I observed something I had never seen before, and I wonder if it is usual.

The flock contained probably 75 ducks. The "leader" circled back from his forward position to about the middle of the left edge of the flock and "nosed" out two members, which flew forward. The two went on ahead, turning slightly to the left as did the flock after them. The "lead" duck went back, and I lost it in the crowd.

Was the latter handing over the leadership?

(Mrs.) GLENOLA B. ROSE.

Penn's Grove, N. J.

It is well known that the leader of bird flocks frequently drops back and is replaced by another bird.

This is most conspicuous in the birds that fly in V-shaped flocks. The students of aerodynamics have figured out that the lead bird actually seems to perform a heavier task than his followers and therefore fatigues more easily. To put it in the simplest terms, the lead bird with his wingbeat produces bubbles of "compressed air," which are thrown backward and outward and are utilized by his followers.

So far as I know, there are very few observations available as to how frequently the leader changes and whether or not the birds shift regularly from the left arm of the V to the right and vice versa. Any amateur observer can make valuable contributions to this problem, as is true for almost any other problem of natural history.

ERNST MAYR,

Department of Birds.

American Museum of Natural History,  
New York, N. Y.

#### Scent Control?

SIRS:

I would appreciate any information you could give me on the question of whether the partridge loses its scent during the nesting season.

(Dr.) HARRY A. BRAY.

Ray Brook, N. Y.

The following information is given by Dr. John T. Zimmer of the American Museum's Department of Birds:

There seems to be no proof that birds actually lose their scent under any conditions. The question is one that has been argued for a long time—probably ever since man began to hunt upland game birds with dogs. It has even been claimed that some birds can deliberately withhold their scent when they wish to escape detection. There is no physiological evidence to support a conclusion that the emission of scent is under voluntary control or that it is seasonal.

When wishing to remain unobserved, birds are likely to crouch down and draw their feathers tight against their bodies—a procedure that makes them appear as small and inconspicuous as possible and that may have the effect of cloaking the body odor from escape into the surrounding air. Immobility also may tend to reduce the intensity of the odor, although I have not seen proof of this. There are no sweat glands, of course, to be stimulated by activity, but the rate of metabolism would be altered.

During the nesting season, the bird on the nest would be relatively quiet and would not be moving about extensively

or very frequently. Some birds (I am not sure that "partridges" are among them) leave and return to the nest by a particular route which, for a ground bird, would considerably narrow the trail that might be discovered by a dog or other enemy, and it might be anything but "warm" when crossed. At other seasons, individuals or a flock roaming across the countryside could be much more easily found.

These various factors all may have their part in the apparent scentlessness of birds at certain times. It has yet to be demonstrated that the scent is quite absent.

#### Regular Tenant?

SIRS:

Today for the fifth successive year a *Hyla versicolor* has appeared in the same decay hole in the same apple tree near my door. I have never marked him but assume that he is the same individual. Throughout the summer he is to be seen frequently sitting at the edge of the hole. None of the books that I have consulted throw any light on the following questions, and I wonder if you can answer them.

(1) Is it known that these frogs occupy the same homes year after year?

(2) If so, am I to assume that he leaves for the ponds about this time and then returns to the place where, presumably, he spent the winter?

JOSEPH WOOD KRUTCH.

Bethel, Conn.

The following answer is offered by C. M. Bogert of the American Museum's Department of Amphibians and Reptiles:

Your letter raises some pertinent questions that have often been discussed but never adequately answered. The best evidence now available is largely circumstantial. Observations similar to yours have been reported, as where one lone tree frog calls year after year in the same garden, and yet it is not altogether certain that it is the same individual.

In instances where frogs or toads have been marked for future identification, the experiments have not been followed for more than one season. In the case of some specialized tropical species, the same individual frog, toad, or tree toad often reappears night after night in the same spot to call, feed, or care for the eggs of its mate. This does not prove that the identical place is inhabited year after year.

In colder climates it is manifest that tailless amphibians disappear during the winter, retiring underground in one manner or another. Moreover, most kinds breed immediately upon emergence in the spring, when air and ground temperatures rise to suitable levels. These differ for individual species, with the result that there is a definite sequence of

#### Answers to quiz on page 370

- |                          |                                |
|--------------------------|--------------------------------|
| 1. Beaver                | 8. White-tailed Deer           |
| 2. Kangaroo and Anteater | 9. Polar Bear                  |
| 3. Lyrebird              | 10. Many lizards               |
| 4. Frog                  | 11. Sting Ray                  |
| 5. Porcupine             | 12. Rattlesnake and Bushmaster |
| 6. Peacock               | 13. Sea Horse                  |
| 7. Scorpion              | 14. Manx Cat                   |

calls in each locality. The same breeding site may be used year after year by the same frog, but seemingly there is no special urge for it to do so. When new breeding sites are created, often in man-made excavations, amphibians breed in such places immediately, even when established sites are present near by.

From a smattering of evidence we may infer that numerous individuals of each species emerge almost simultaneously and move about immediately in search of suitable places to carry out their reproductive activities. It has not been ascertained whether their movements are random or whether they respond to moisture gradients or to odors of water vegetation, as has been suggested. But the first males to arrive immediately begin to call. Other males and, later, females are thereby attracted to the vicinity.

Enormous choruses sometimes result; hundreds of individuals may assemble in one pond to mate and deposit eggs within a day or so.

Once the eggs have been laid, frogs and toads of both sexes turn to the matter of finding sustenance. Most tailless amphibians have no further interest in the breeding pond and may simply scatter at random in search of suitable places to feed at night and to secrete themselves during the day. It is quite possible, but unproved, that the same "home" is chosen year after year. At any rate, the site selected is ordinarily inhabited for most of the summer season unless drought forces retirement or movement. A rather limited area is patrolled; some species remain within a few yards of an adopted burrow, commonly that of a rodent, and an individual may venture forth to breed

if spring rains are delayed, and return to the same burrow. But until someone actually tags such an amphibian and retrieves it on successive years, we can never be certain that each frog has its own home territory. Often several toads will occupy the same retreat, so it is evident that it is not defended from intruders. But this does not preclude the possibility that it is resought season after season.

Various tags have been devised to mark all sorts of vertebrates for future identification. Some enterprising naturalist fortunate enough to have amphibians living in his yard may come forth with an answer that does not involve assumptions. Migrations and homing are ceaselessly interesting, and almost anyone with a little ingenuity can make his contribution to our limited knowledge.

► LIKE HARD-HEADED SENTINELS, this group of hoodoos has defied the ravages of weather near Field, British Columbia, in the shadow of a U-shaped sky line reminiscent of the glacier that carved the landscape on which they stand

▼ TALL HOODOOS like these are nearing the limit of their existence, for the capping boulders cannot protect the columns much longer



## HOODOOS

*Photographs by*

LEONARD H. LEACOCK

FANTASTICALLY shaped rock piles are sometimes called "hoodoos." They may result from various causes, but the piles shown here illustrate an unusual erosional process. Each column has been protected from the destructive action of rain water by the boulder resting upon it.

The sky line in the horizontal picture shows the typical U-shaped valley carved by a glacier in former times. The material in the foreground, ranging from fine silt and gravel to fairly large boulders, was

left along the side of the valley by the glacier after it had completed its gouging action and had melted away. Most of the debris, being loose material, has been easily washed away by the rain and snow through many seasons, but the resistant boulders have not only resisted erosion themselves but have protected the underlying material from being washed away. But each will topple and fall, because the best roof cannot make up for a weak foundation.

Sometimes a similar formation is produced in ice, when a flat boulder is left supported on a column on the surface of a glacier. But in that case it is from the sun rather than the rain that the capping boulder protects the underlying column.





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November **NATURAL HISTORY** 1948

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# LETTERS

## Color Lost in Captivity

SIRS:

Last week while visiting the San Diego Zoo, I was told that after the flamingos were kept in captivity for a while they lost their scarlet coloring. Could you tell me more about this?

D. L. SAWYER.

Los Angeles, Calif.

All birds of intense red coloring of a certain nature, such as flamingos, tanagers, scarlet ibises, and spoonbills, lose their natural coloring when living in captivity. Under these artificial conditions, they are deprived of certain natural foods necessary for the production of red pigment. Also, the areas to which they are restricted often lack sufficient lime and iron in the soil and thus in the water they drink, and these minerals are necessary for good coloring. So after molting occurs, the new feathers will be whitish or dusty pink, instead of bright red.

If the bird is given a wide enough range in captivity, it will seek out its natural food and thus retain its coloring. If this is not possible, feeding the birds "red food," such as carrots, tomatoes, chili peppers, and the like, and supplying them with lime and iron compounds, will build up the red pigment, and the change in coloring will not occur.

JEAN DELACOUR,  
Research Associate.

American Museum of Natural History,  
New York, N. Y.

## Varicolored Insect Cases

SIRS:

While in Glacier National Park in June, my husband and I found a curious insect on the edge of a sparkling icy stream. The bed of the stream was lined with pale green and red stones, some of them quite small bits. The surrounding rocks were all of the same colors. About an inch from the bank in just enough water to cover it, we found the inch-

long tubular object depicted in the accompanying drawings.

It was made up of tiny flat stones of the same red and green color. As I picked it up, a small head oozed out of the narrower end and then a very slimy, pale body and six wary legs. The insect seemed attached at some point to the inside of the tube and alternated between trying to get completely out and hurriedly withdrawing.

Each tiny stone was cemented to or overlapped the next, and the whole was a very firm bit of masonry, as well as an excellently contrived disguise.

Can you tell us what it was, how it glued its house together, and why it lives in a stream?

MRS. WILLARD E. GOODWIN.

Baltimore, Md.

The following information is offered by Dr. C. H. Curran of the American Museum's Department of Insects and Spiders:

The insect to which Mrs. Goodwin refers is a caddis fly larva and probably belongs to the genus *Limnephila*, the larvae of which generally use sand or small pebbles to cover their cases. Unfortunately, the larvae, cases, and adults of most of the numerous kinds of caddis flies have not been associated, largely because of the difficulty of rearing them.

The adults of some species crawl under water to lay their eggs, or deposit them on stems and leaves at the water's surface. Some kinds lay egg masses on leaves above water, and the young drop into the water upon emergence.

The first job of most young caddis worms is to provide protection. This they do by spinning a silken case to which they fasten sand, stones, sticks, or other debris, depending upon the kind of caddis. Some live in silk-lined, hollow grass stems, others build nets in fast-flowing water, and a few live an unprotected life. Often the species can be determined by the case and the arrangement of the materials composing it. As the case-builders grow, they increase the size of the case. When the larva is mature, it seals up the



▲ SNOWY EGRET by Edward Fleisher

ends of the case with silk, sometimes adding sand or pebbles to form a protective door, and transformation to the adult form takes place within. The adult emerges under water, rises to the surface, and flies to a near-by resting place in order that its skeleton and wings may harden.

The use of different colored pebbles depends entirely upon the colors available, and there is no evidence that the larvae show any selectivity in the colors used. When raised in an aquarium, the color of the cases can be influenced by furnishing pebbles or sand of any desired color.

Various species of caddis flies are of great importance as a source of food for fishes.

## CONSERVATION

### The Sugar Pines at Beaver Creek Valley

In the February, 1948, issue of NATURAL HISTORY, Dr. Van Name called attention to the need for immediate action if the finest existing example of the sugar pine-ponderosa pine forest is to be saved. The logging railroad of the company that owns the tract has now reached the south end, and cutting may start any day.

The Beaver Creek sugar pine stand which he described in his article is a uniquely beautiful forest and is separate and distinct from the South Calaveras Sequoia Grove which is already slated for acquisition as a state park under the auspices of the Save-the-Redwoods League. The pine stand occupies about 800 acres along the northwest side of the sequoia grove. The spectacularly large trees occupy an area running north almost to Beaver Creek for a distance about three miles above Big Tree Creek.

Continued on page 432



Alternating red  
and green stones



Small, round hole

# NATURAL HISTORY

*The Magazine of the American Museum of Natural History*

F. TRUBEE DAVIDSON, President

WAYNE M. FAUNCE, Vice-Director  
In charge of Publications

ALBERT E. PARR, Director

VOLUME LVII—No. 9

NOVEMBER, 1948

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## THE COVER THIS MONTH

The Indian portrayed on the cover of this issue is a representative of the Tarahumara tribe of northwestern Mexico.

The Tarahumaras have long been famous for their ability to run great distances. Individuals are reported to have run 170 miles without stopping and to have covered 500 miles regularly each week on a mail route.

Otherwise, the Tarahumaras remain little known and rarely photographed, for they keep largely to themselves in the recesses of the lonely Sierra Madre Mountains. Their culture is simple and their life a frugal one, combining farming and hunting. They still weave cloth using natural dyes, hunt with the bow and arrow, and poison fish in streams.

George McClellan Bradt, who took this photograph, visited these remote cave dwellers in their rugged homeland in company with his wife.

The story of their recent journey is given in an illustrated article beginning on page 392.

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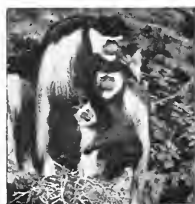
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### PHYSICAL GEOLOGY

--- by Chester R. Longwell,  
Adolph Knopf and  
Richard F. Flint

3rd Edition, John Wiley & Sons, \$5.00  
602 pp., 365 figs.

THE first two editions of this popular book have played a significant role in the later development of geological science in America, because it is the most widely adopted elementary college textbook on general geology. In spite of the fact that it is written primarily for students in the first college geology course, the new book is more readable and far more authoritative than the majority of so-called popular books on geology. The authors have written for nontechnical readers, and all science students will want a copy for their reference libraries.

In 21 lucid chapters and 4 appendices, the authors tell the fascinating story of physical geology. Introductory chapters clearly define the scope of geology and its methods. In subsequent chapters, geologic processes such as weathering and erosion, and their effects by various agencies, are adequately covered. Other subjects are the erosion and formation of deposits in the sea, the origin and alteration of rocks within the earth, volcanoes, crustal deformation, mountains, earthquakes, the interior of the earth, land forms, and mineral resources.

Some factual material such as descriptions of common minerals and rocks, discussion of topographic maps, and the Geological Time Scale are placed in appendices in order to remove these data from the body of the text.

Improvement of the illustrations has received particular attention in the new edition, because of the special value that good illustrations play in presenting this varied subject. A number of new and effective photographs and several new reproductions of previously used photographs, bled at the margins, show markedly finer detail and greater contrast than in former editions. The striking improvement is due to the increased size of the pictures, aided by the use of pure white-coated paper. Numerous shaded diagrams illustrating topography and geologic structure utilize improved techniques in drawing and engraving and create the rarely attained illusion of depth in three dimensions. The authors and their publisher are to be congratulated for this fine book.

NORMAN D. NEWELL.

### ANIMAL FACTS AND FALLACIES

----- by Osmond P. Breland

Harper & Bros., \$3.00  
268 pp., 18 drawings

DEBUNKING has always been a popular pastime. Recently there has been a minor deluge of articles in papers, magazines, and books by authors attempting to destroy some of the more common misconceptions, fallacies, and superstitions about our natural world. Interestingly enough, most of these authors have not been professional people of science.

Here, however, is a book on animals by a zoologist. Dr. Breland, Professor of Zoology at the University of Texas, has spent ten years collecting the material for this work. Museum people will recognize many of the questions as old familiar friends. They are typical of the questions lay people call upon the museum staff to answer—the kinds of questions curious children, students, and adults ask about animals. They are not profound questions, nor are they necessarily indicative of a serious scientific interest on the part of the questioner.

For the most part the form used in the book is in question and answer form. Only vertebrates are considered in the five major divisions of the book—mammals, birds, reptiles, amphibians, and fishes. In certain instances when considering comparative material such as life span, jumping ability, speed, and height, charts are inserted for clarity and for easy comparison. Beyond the simple division of the book into five sections the material does not appear to be organized. Items are inserted at random, but this is not necessarily a handicap as there is a good index. The book is designed for use as a handy reference rather than to be read at a single sitting.

A wide variety of matter is included, ranging from the antics of snakes, bats, electric eels, elephants, and pelicans to the subject of how porcupines mate. Pro-

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# Wings in the Woods

By ROBERT M. McCLUNG

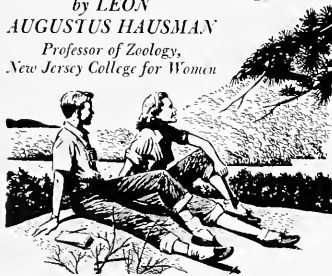
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are reading it  
with delight!

# Bird Hiking

by LEON  
AUGUSTUS HAUSMAN  
Professor of Zoology,  
New Jersey College for Women



HERE'S a charming and informal invitation to a wonderful outdoor pastime. A famous ornithologist and a completely enjoyable writer, Dr. Hausman covers everything from the necessary food and equipment to the techniques of nest-collecting, clues for identifying birds, habits of flight, "address lists" for many species, etc.

Bibliography of books on birds and on other phases of nature encountered on bird hikes.

25 illustrations by Harold J. Minton.

\$2.00, at all bookstores  
RUTGERS UNIVERSITY PRESS  
New Brunswick, N. J.



fessor Breland's sources represent some of the outstanding authorities in the natural science field, including a number of members of the American Museum of Natural History's scientific staff. Clever illustrations by Leo Herschfield decorate the book, and a bibliography is also included for those who wish to delve more deeply into natural history.

JOHN R. SAUNDERS.

## SILVA OF NORTH AMERICA

- - - by Charles Sprague Sargent

Peter Smith, 321 Fifth Avenue  
New York City, \$200

AN offset reprinting of two hundred sets, in which the fourteen volumes are bound in seven, gives one an opportunity to buy this outstanding work on North American trees at a very reasonable price, since the original issues have been selling for about \$500. Sargent was former director of the Arnold Arboretum of Harvard. In the 1890's, with the financial aid of Morris Ketchum Jesup, he assembled the trees now on exhibition in the Forestry Hall of the American Museum of Natural History, a collection which never again can be duplicated due to the depletion of American forests.

The large engravings of the *Silva*, illustrating in detail virtually all the species of trees north of Mexico, are perhaps the finest examples of botanical artistry produced in this country. Though primarily for the botanist, the set is a veritable gold mine for the general reader interested in the history, distribution, and usage of trees. Particularly it should form a good background for the smaller books now issued for localized areas, such as the "southern states" or the "northeastern states"; these are ordinarily illustrated by photographs and usually lack the fine diagnostic features of the Sargent illustrations.

H. K. SVENSON.

## DAYS WITHOUT TIME

- - - - - by Edwin Way Teale

Dodd, Mead & Co., \$6.00  
283 pp., 144 illu.

IT has come to a time when another book by Edwin Way Teale means another milestone in the recordings of the ever-thrilling facts of Nature—of the common natural phenomena that occur about us every day of our life. Most of us are too busy or too ignorant of what is going on to observe the struggle for existence made by the animals and plants that are present on every city street and in every back yard. In the suburbs and in the country, where the fight may be less arduous, more and more varied kinds of plants and animals grow and prosper. But if you read *Days Without Time*, you will realize that every living plant and animal has its enemies, whose object is to feed

upon the prosperous plant or animal and to prosper themselves even though the host must die. You will also discover that insects in particular are of service to plants and that the majority of plants are dependent upon insects for their very existence—through pollination of the flowers.

The book is a series of some 29 essays on natural history, and it deals mostly with insects. Practically all of the 144 illustrations are of top quality; indeed, most of them are classics in their field. Many of the subjects covered are so commonplace that the layman passes them by without thought of the drama that lies behind their very existence. Those, for instance, who see the starling as a defacer of buildings, cars, and streets do not realize its value in the control of the Japanese beetle and other related pests. Teale mentions that 40,000 starlings spend the night at a bridge near Grant's Tomb. The George Washington Bridge is visible from Grant's Tomb, but the Bridge referred to is the viaduct near the west end of 125th Street. It would have been much better historically and factually to have mentioned the name of the bridge. Nevertheless, the book is a record of facts and experiences presented in a most entertaining way and will be a valuable addition to any bookshelf.

C. H. CURRAN.

## THE HUNTER'S ENCYCLOPEDIA

- - edited by Raymond R. Camp

Stackpole and Heck, Inc., \$17.50  
The Telegraph Press Bldg., Harrisburg,  
Pa.

1152 pp., 753 illu.

THIS large volume is the work of over 50 experts and covers a wide range of subjects of interest to hunters, many of which are also of equal interest to any outdoorsman. Almost half the book is devoted to detailed information about the birds and mammals that are either regularly hunted or likely to be noticed by hunters. The remainder deals with a multitude of subjects ranging from firearms and hunting dogs to camp craft and photography.

The foreword on the history of hunting activities—a brief review of the published writings on the subject and the present status of hunting in North America—is very well done. Equally good is the detailed discussion of the history of the big game mammals of the continent and the probable future of each. Especially notable and encouraging in a book written especially for sportsmen is the emphasis on habitat preservation as the key to most of our wildlife conservation problems. And the recognition that the carrying capacity of the land and not predators is the chief factor in determining the game population of a given area.

The mammals are divided into big game, small game (including even prairie



dogs and woodchucks), animal predators, and small mammals, each group being handled by a different author. The big game accounts are well illustrated with range maps, photographs, diagrams of tracks, and methods of measuring trophies. It is gratifying to find such maligned predators as the coyote, cougar, and wolf given recognition as having a value as game and a place, in controlled numbers, in our wilder natural areas.

All the ducks, geese, grouse, and doves are covered in detail, and so are a few of the rails and shore birds. This entire group is illustrated in color in a series of seventeen color plates. It is curious to find in the accounts of the pheasant, bobwhite, and turkey a continuing faith in the efficacy of the now thoroughly discredited technique of attempting to improve hunting by artificially rearing and stocking these birds—a rat hole down which the states are unfortunately continuing to pour millions in game funds, which the sportsmen should insist be spent for land acquisition and habitat improvement. A whole section is given to the hawks and owls. All the important species are covered and illustrated with photographs. The accounts of their habits are excellent and factually correct. They should help the recent efforts that sportsmen's organizations and naturalists have been making to bring about a better public understanding of these species.

The sections on firearms, ammunition, and shooting seem very complete and that on hunting dogs exceptionally well done. A great number of lesser topics, including falconry, archery, blinds, boats, and trophy preparation, receive a few pages each at the end of the book, which closes with a state-by-state summary of hunting conditions and regulations and a map of the major public land units in each.

Ray Camp, of the *New York Times*, has done a remarkable job in pulling together and editing such a vast amount of material. This is a book that should long stand as a monumental work on the subject.

RICHARD H. POUGH.

## READINGS IN THE PHYSICAL SCIENCES

- - - by Harlow Shapley, Helen Wright, and Samuel Rapport

Appleton-Century-Crofts, Inc., \$3.00  
501 pp., 4 illus.

THIS volume is correctly titled. It is just what it pretends to be, a collection of readings in the physical sciences—and a fascinating collection it is. It is

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arranged in six groups, namely, Science and Scientific Method, Astronomy, Geology, Mathematics, Physics, and Chemistry. The high quality of the readings is assured by the outstanding scholarship of the editors. The articles are written by some 50 of our most prominent American and British scientists. It is seldom that we find so great a number and variety of subjects brought together.

In Part One we have an analysis from Aristotle to Einstein. Among eight or ten others, the old master in this field, T. H. Huxley, naturally falls into this section. In Astronomy we have from Copernicus and Galileo to Great Britain's Astronomer Royal, H. Spencer Jones, and Sir Arthur Eddington. In Geology we find the Scottish geologist and others working on such problems as Weighing the Earth, X-raying the Earth, Earthquakes—What are they?, Age of the Earth, and the Weather. In Mathematics we have Poincaré and Bertrand Russell.

In the section on Physics we have Newton, Benjamin Franklin, and Madame Curie. In Part Six we have our leading chemists. Altogether the editors have brought together a most impressive array of readings, thus performing a distinct service for the layman who is interested in science but who would not know where to turn for such material without great expenditure of time.

From every point of view, this is an ideal book of its kind and one for which many readers will be most grateful.

CLYDE FISHER.

## FLIGHT INTO SUNSHINE

Bird Experiences in Florida

- - - by Helen G. Cruickshank

The Macmillan Co., \$5.00  
196 pp., 121 illus.

THE author is the wife of the famous bird photographer Allan D. Cruickshank, 121 of whose beautiful pictures are reproduced in a special section at the end of the book. Each of the dozen chapters tells in a pleasant, informal fashion the story of their experiences while studying and photographing some one of Florida's many colorful avian inhabitants.

Those who are planning a trip to Florida will find this a helpful guide to many of the more outstanding wild areas. Those who are not will find Mrs. Cruickshank's colorful account an excellent substitute.

Most of Florida's best-known birds appear in these pages, such as the common brown pelican, the stately Florida crane, and the strange snakebird, to mention but a few. Here, also, are the answers to the often-asked questions about how bird photographers carry on their occupation. As might be expected, it turns out to be largely a matter of hard work and almost infinite patience, frequently under the most trying circumstances.

The author very expertly works into

*Continued on page 132*

## New Books for Your Nature Library

### Ant Hill Odyssey

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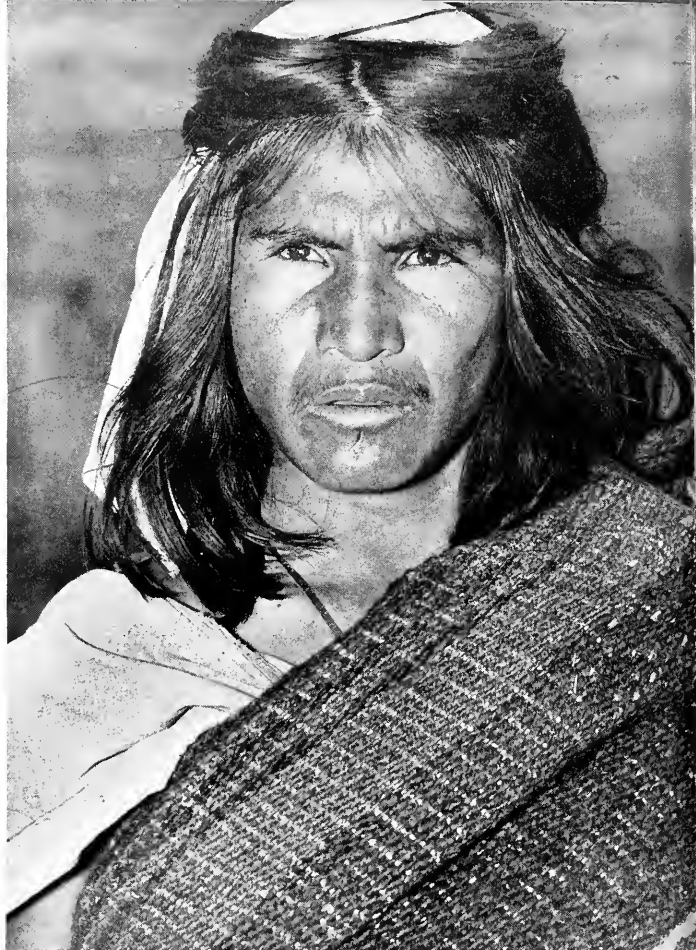
LITTLE, BROWN  
& COMPANY  
BOSTON 6, MASS.

➤ PORTRAIT OF THE PAST: a young Tarahumara Indian with long hair, some of it tucked under his headband

WHO has not at one time or another wondered how the American Indian looked and lived before the coming of the white man? Who has not wished to turn back the calendar 300 buried years or tried to visualize the cliff houses of Mesa Verde repeopled with their vanished tenants? Most of us have, but we dismiss such thoughts as mere wishful thinking, unaware that in the mountains of northwestern Mexico, 150 miles south of the U. S. border, live members of a tribe of American Indians who maintain to this day a culture that is in many ways aboriginal. They are the primitive Tarahumaras, cave-dwelling inhabitants of the great, lonely Sierra Madres of the Mexican state of Chihuahua.

It is estimated that 40,000 of these mahogany-hued people still live in an otherwise almost uninhabited and inaccessible area of 17,000 square miles. Ethnologically they are considered to be one of the ten Uto-Aztecan tribes forming one continuous Indian population from southern Arizona to the Mexican state of Jalisco. The Pimas and Papagos of Arizona comprise the most northern elements; the Yaquis, Mayos, and Opatas make up the so-called Sonora-Sinaloa subarea; and the Tepehuanes, Coras, Huichols, and Tepecanos form the southern groups. The Northern Sierra area, lying roughly between the twenty-sixth and twenty-ninth parallels of latitude, a region of lofty coniferous forests and precipitous canyons, forms the almost exclusive domain of the troglodytic, or cave-dwelling, Tarahumaras.

To see these indigenous Americans in their native environment, sandal-footed and half-naked, is like returning to the seventeenth century and seeing the Indian through the eyes of Jesuit *padre* and Spanish *conquistador* as they met him on their paths of conversion and plunder. For his nominal acceptance of the white man's authority and religion rests but



## THE TARAHUMARAS

Many have heard of the famous long-distance runners of northwestern Mexico, but few have visited them in their primitive rock shelters in the lonely Sierra Madre Mountains

By GEORGE MCCLELLAN BRADT

*Photographs by the author*

superficially upon the wide, firm base of his own primitive culture. Despite three centuries of almost constant European contact and influence, the Tarahumara remains a savage.

One's first glimpse of a Tarahumara in the flesh is apt to come as a distinct shock. His bent-knee gait, staring gaze, and tangled hair make him look decidedly savage,

almost subhuman—like a fossil come to life. In fact, there are few sights more incongruous than a group of silent, sandaled Tarahumaras treading single file along the paved sidewalks of Chihuahua's capital city. The men are barelegged and breechclouted, their long hair bound by crimson headbands, and they are armed with short bows and long feather-shafted arrows. Be-

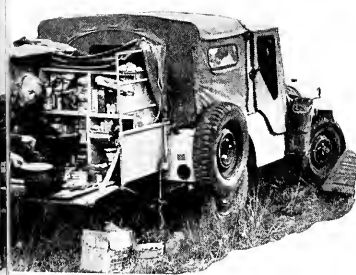
► **CANYON HOME** of the Tarahumaras. At the base can be seen two men hoeing their maize. Their cave homes are beyond them. Pines line the canyon rim

hind them follow the round-faced women in voluminous skirts, with black-haired infants cradled in thick brown blankets wound over the shoulders. The Tarahumara is a human anachronism. He has been overlooked by progress, ignored by civilization, and forgotten by time.

Occasionally you can see Tarahumaras in the markets of Chihuahua City, Parral, Santa Barbara, and, rarely, in Ciudad Juárez across the river from El Paso. During the cold winter months they make distant, protracted trips on foot from their snow-filled canyons to the lower and warmer areas of towns and cities. After the corn, bean, and squash crop has been harvested, many Indians bring little bundles of aromatic medicinal herbs and bear-grass baskets to sell in the Mexican pueblos to housewives and market vendors. With the pittance they receive they purchase their few necessities and luxuries—a meter of unbleached muslin (mantá), a red bandana, a piquant chili or two. These weeks-long, hundred-



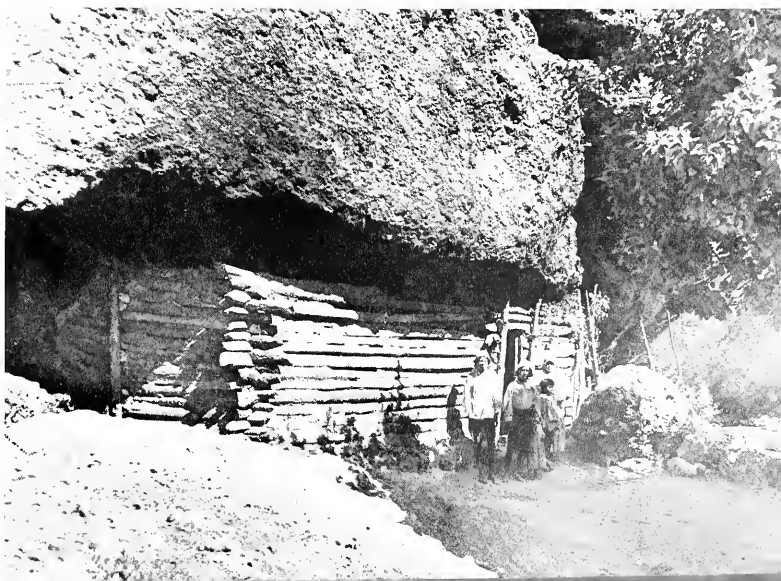
## AR twentieth-century cave dwellers



▲ **MRS. BRADY** "in the kitchen" of the jeep that took them there

► **ONE OF THE MORE ELEGANT** cave houses. The Tarahumaras have walled up the front of the cave with logs to form a cozy retreat, safe from cold, winter winds, and driving rains

THE TARAHUMARAS



anners of  
in their  
Mountains

fossil come  
few sights  
a group of  
Tarahumaras tread-  
saved side-  
capital city  
aged and  
long hair  
hands, and  
short bows  
arrows. Be-

BER, 1948

and-more mile pilgrimages are made by entire families and are often the Tarahumara's sole contact with the white man and his strange ways. Once in town, they lean against door jambs and peer mutely into shops and taverns, attend the *cine* without charge, and even poke their wild heads into open windows to observe firsthand the home life of their conquerors.

Unlike the Indians of the American Southwest, who work in silver and turquoise and are noted for their baskets and pottery, the Tarahumaras are not known for their artistic craftsmanship. Their culture is an extremely frugal one, and their few and simple artifacts are limited to such utilitarian objects as blankets, ollas (clay vessels), baskets, and bows and arrows. The single exception is their often expertly carved violins. They are also without the complicated social organizations typical of most North American Indians, because their seminomadic existence makes living in anything but small family units virtually impossible. But despite the seeming paucity of noteworthy cultural traits, the Tarahumaras have attained a degree of popular fame by virtue of their almost superhuman physical endurance.

The word "Tarahumara" may be freely translated as "foot runner" and was first applied to these In-

dians by Mexicans who realized that their ability to run and walk tremendous distances was truly phenomenal. The fleet-footed Tarahumaras have often been employed as couriers and porters. One early traveler, Lt. Frederick Schwatka, reported a mail run of 500 miles made weekly by a single runner. The Indian ran 250 miles from Chihuahua City to Batopilas in three days over some of the roughest terrain in North America. After a day's rest, he would return to the capital in the remaining three. Carl Lumholtz, exploring the Sierra Madres in the 1890's, knew a young Tarahumara who carried a hundred-pound load on his back 110 miles in 70 hours. He tells of others who were known to have run *170 miles without stopping!* With good

reason he called them "the greatest runners in the world."

This amazing ability results not only from centuries of rugged mountainous existence, where an absence of beasts of burden made walking and human portage obligatory, but also from the Tarahumara's devotion to his favorite sport—kickball races. These curious contests are run over a two- to twelve-mile course and may last from a few hours to a day and a night. In addition to running, each contestant must kick a small pine ball over the entire distance. While their pace is steady rather than fast, Lumholtz witnessed races in which four miles were covered in thirty minutes and others in which forty miles were run in six to eight hours. So proverbial, in fact, is the Tara-



▲ THE AUTHOR'S HOSTS at the canyon of the twentieth-century cave dwellers: a family of ranchers who upheld the reputation for gracious hospitality proverbial among the Sierra folk of northwestern Mexico



▼ A YOUNG WOMAN shows how corn is ground on the ancient stone metate by rubbing the handstone (*mano*) back and forth over the dry kernels



humara's endurance that Mexicans love to tell the story, doubtlessly apocryphal but highly plausible, of a Tarahumara who was challenged by an able Mexican runner to a race between two towns twenty miles apart. The Indian immediately accepted and then proceeded to disconcert the Mexican by guilelessly asking, "How many laps?"

My wife and I first became interested in these Indians soon after we began teaching in a mining company school in southern Chihuahua. During the cool fall months we had watched them coming into our town of Santa Barbara—jogging across the oak-studded hills, walking the rocky trails single file, and trotting along the road kicking a wooden ball before them—and we wondered how we might make

their acquaintance. Because they were as shy as wild turkeys and justifiably suspicious of the white man, they almost had to be corralled before they would stop to talk. We finally hit upon a scheme, however, which would produce Tarahumara models for our camera and still give them an opportunity to decide for themselves whether or not they wished our company.

We had at the time several young Mexican boys employed as hunters to collect snakes and insects for the American Museum of Natural History and to keep our school zoo stocked with the odd *animalitos* of the region. To the list of desired specimens we simply added "Tarahumaras." The hunters were instructed to bring to the school any Indian willing to pose for his picture. He would be shown the zoo and rewarded with food or money for his co-operation. This arrangement proved an exceedingly happy one, for on an average of once a week all winter long our hunters led a veritable parade of perplexed but friendly Tarahumaras to the school and our camera.

Among our first visitors were two young Indians, an extremely bashful brother and sister. Although obviously curious, they could not be induced to enter the school without much encouragement from the hunters and myself. But once inside, they lost much of their timidity and proceeded to inspect our pets with interest, exchanging occasional guttural, monosyllabic comments about the zoo's inmates and, doubtless, the school's. The pupils were

fascinated by the Indian children, and one asked if she might exhibit our gentle bull snake to the visitors. As she removed it from its cage, the Indian boy asked, "Pica?" ("Does it bite?") Carolyn Lee, the bull snake's keeper, assured him that it would not and offered to let him hold it. But he immediately and emphatically refused—a reaction we had observed in most of our non-Indian visitors as well. Since Tarahumaras often dine on rats, mice, lizards, insect larvae, and even snakes, their interest in the fauna of their area is probably dietary rather than zoological. Perhaps if Carolyn Lee had offered the snake as a meal instead of as a pet it might have met with more approval.

On another occasion the hunters brought in a young Tarahumara couple. At first they were the epitome of reticence, but after a little present of cheese and crackers they furnished the following personal information. They had been on the trail five days and nights, walking the daylight hours, sleeping away the others, all the way from their village of Nonoava far to the northwest. Their only food was a small sack of pinole—a finely ground meal of parched corn, which is mixed with water and eaten as a kind of gruel. The young man's name was Mateo Cruz, the girl's Lijia. As most Tarahumaras are professed Catholics, they have replaced their tribal names with Christian ones. We also learned that Mateo and Lijia had just been married. The groom appeared considerably more sophisticated than his wife, prob-



THEY HUNT deer and rabbits with the bow and arrow, although the usual method of the remarkable runners is to chase a deer on foot. This young Tarahumara traded his bow and arrows for a red bandana, some bleached muslin, and a handful of candy

► INDIAN with white man's bow. Jack Maxwell, Canadian archer, let the Tarahumara try his weapon. Though accustomed to a much shorter bow, the Indian did well



FIG. TARAHUMARAS





▲ AN EXCEEDINGLY WARM "OVERCOAT" is made by wrapping the dark-brown Tarahumara blanket around the body



▲ CONTRAST IN COSTUMES: Tarahumara, barelegged and blanketed; Nancy Urquhart in slacks and fur coat. Notice similar hairbands, dissimilar footwear



▲ LIJIA, who with her husband made a five-day honeymoon trip to town on foot. Her skirt, blouse, and headdress are of unbleached muslin (*manta*). Her jewelry consists of strings of glass beads



◀ MRS. BRADT bought this entire nest of nineteen baskets for five pesos (about one dollar). The long bundle on the ground is material for brooms

ably because of previous trips to town, and was doubtless showing his bride "the sights" on this ambulatory Tarahumara honeymoon.

Mateo had arrived carrying a bundle of split bear grass tied up in a piece of *manta*. When we asked him if he were going to weave baskets, he replied that he did not know how but that his *mujer* (woman) would make them. We suggested that they spend the day making the baskets in the shade of the school building and offered them a wash tub in which to soak the grass. In return, Lijia posed for photographs and showed our pupils how she manipulated the pliant *Nolina* leaves. When her first basket was finished, she handed it to Mateo, who bit off the protruding ends, as neither of them possessed a knife. To give the still moist basket its final shape. Lijia placed a bare foot inside it and pulled and moulded until it suited her. The Tarahumaras today make only sin-

gle- or double-weave twilled baskets; in preconquest times they made a coiled variety. The commonest ones are of single weave, called *petacas* by the Mexicans, always round and shallow, although in a number of different sizes. The rare pinole baskets are of double weave, deep and bowl-like with a tightly-fitting circular cover. By the time classes were over, Lijia had completed a nest of five baskets. When we asked how much she wanted for all five, her husband repeated the question to her in Tarahumaran. Her one-word reply was

translated as "*un peso*" (20 American cents).

Indians often came in with personal belongings which were not for sale but which we wanted for our collection of Tarahumaran artifacts. Blankets were most difficult to secure, for without his *cobjia* a Tarahumara would be practically bare and exceedingly cold. If it were not for these heavy woolen blankets, it would be impossible for even the hardest Indian to withstand the bitter cold of a Sierra winter. We did succeed in parting one Tarahumara from his blanket by trading him one from our own bed plus a goodly number of pesos. Violins, however, appeared to be in a different category—more luxury than necessity. Before the coming of the Spaniards, the musical instru-



ments of the Tarahumaras were limited to the drum, rattle, reed flute, and rasping stick. The violin represents a post-Hispanic development and is now used at the Indians' celebrated *matachin* dances and *tesguinadas* (drinking parties). Once a tall Tarahumara appeared at the school with a violin he had carved by hand with no other tool than a penknife. The strings were of sheep gut, and the bow was strung with horsehair. Although he insisted he could not play the instrument, he posed with it for a photograph.

With the Tarahumaras, bargaining is not so much a matter of price as of inducing the Indian to relinquish the article in question. I wanted the violin and began business by asking if he would sell it. No, he did not want to part with the violin. I told him I would pay a good price. Would I pay ten pesos (the equivalent of two American dollars)? This seemed to me a ridiculously low figure for the expert workmanship and patient hours that had gone into its construction, but as that was his price I paid him and received the violin. He left violinless but obviously satisfied.

It was not until some time later that I heard of another Indian violin transaction. A friend and neighbor once met an Indian with a violin, asked him the price, and was told two and one-half pesos (the exchange was higher in those days, and inflation was but a word in the dictionary). Feeling that it would be unfair to accept such fine work for so little, he offered the Indian a five-peso note. The Tarahumara stared at the bill, then at the American, again at the bill, and without so much as a polite *con permiso*, turned on his sandaled heel and trotted away with the violin clutched tightly under his arm. A single word was doubtless repeating itself in his simple but practical mind—*loco, loco, loco!* Through the streets our friend followed the retreating Indian, asking again and again for the violin, but to no avail. Finally sensing the trouble he called, "*Dos cincuenta.*" Immediately the Indian stopped, turned, and held

out a brown palm. Carefully the would-be purchaser counted out exactly two pesos fifty centavos and was presented with the instrument. After a brief interchange of *gracias*, *adios*, and *que le vaya bien*, the two parted—the American with the violin and a lesson in Tarahumara psychology, the Indian well pleased with the trade and satisfied that the white man had regained his sanity.

The medicinal herbs of the Tarahumaras are credited with almost panacean properties by Indians and Mexicans alike. Implicit faith is placed in the efficacy of innumerable native plants, and every market displays small baskets of twisted roots, pieces of rough bark, and dry fragrant leaves. Aromatic teas made by boiling or steeping these miraculous herbs are used to cure everything from the common cold to pneumonia. From a visiting Tarahumara herbalist we learned the names and cures attributed to some of the commoner elements of the Indian pharmacopoeia. About the old man and his belongings clung the definite, rather pleasant, herbaceous aroma that we have come to consider distinctively Tarahumaran. He carried a small bag of strange woody packets tied with yucca fibers. We bought specimens at five centavos a bundle; and after being paid, he bit into each one, savored the flavor a moment, and then told us its name and use. One was a bunch of thin, dry sticks with a delicious celery-seed odor. This was *matarique*, which is pounded and boiled to make a hot tea for the treatment of colds or chewed into a paste and applied as a poultice for rheumatism of the knee. *Calcomeca*, fibrous and vinelike, was also for the *reuma*. Another was the slim, pungent root called *chuchupaste*, very good for all stomach troubles. *Peonia*, podlike and spicy, was for general aches and pains. There were others—*te de limón*, *hojas de naranja*, *lecotoco*—a mere fraction of the hundreds of native plants making up Mexico's *materia medica*.

Another visitor was Antonio Cruz, a fine specimen of Tarahumaran manhood, tall, straight, and

muscular, with little of the timidity so typical of these Indians. His costume was the usual manta breech-clout, red headband, and *guaraches* (sandals) cut from old tires, the treads still visible on the soles. Added to this was a bright shirt of a patterned red cloth, a cotton tunic, and a handsome, wide, woven belt. He spoke Spanish well and answered our questions willingly. For seven days he had descended shadowy canyons and climbed wooded ranges as he made his way alone and on foot cross-country from Baquiachic. Asked if he could not have borrowed a horse for the long trip, he replied that he could have but that on horseback the trip would have taken much longer—a horse must stop to rest! On the trail Antonio had caught fishes with his hands and killed rabbits with rocks to augment his pinole diet. He well typified the solitary, possessionless self-sufficiency of the average Tarahumara. Without weapons or tools other than bow and arrow, ax and hoe, or habitation other than cave, windfall, or rude log hut, and leading a half-nomadic existence without employment or money, these Indians manage to exist and multiply in a highly inimical environment, in spite of the often destructive influence of the white man's civilization.

To prolong our visit with Antonio we invited him to share some coffee with us. While it was being prepared I showed him copies of *Life* and my collection of Indian and wildlife photographs. He seemed entranced with all he saw, nodding his head and mumbling unintelligible words under his breath whenever he came across a picture he could comprehend. But of all the pictures he saw, the one he liked the best was a large advertisement in color of a pair of Florsheim shoes. Rubbing his hand over the advertisement again and again, he murmured, "*Zapatos, zapatos*" ("Shoes, shoes"). After the coffee, our obliging guest agreed to pose in his red shirt and our one Tarahumara blanket. When he finally left, he was smiling and talking to himself as if trying to fix in his mind for later telling all

the odd things he had just seen. He began his long journey home carrying food and money, a couple of old army shirts, and several issues of *Life*, which are undoubtedly still going the rounds of smoky Tarahumaran caves.

By the time spring had returned to the mountains of Mexico we had seen, talked to, and photographed two dozen Tarahumaras. With each visitor our interest in these Indians had increased, until we knew we would not be satisfied until we had returned their "calls" in person. As soon as school was over for the summer, we found ourselves "jeeping" westward on the only road into the mountains of the Tarahumaras.

Late the first afternoon we reached the valley of the Rio Balanza. In the distance we could see the mighty Sierra Madres rising range upon forested range into the turquoise sky. We began climbing soon after leaving the valley and

by sundown were among junipers and low pines. Since the road was becoming progressively narrower and steeper, we stopped to make camp before nightfall. In every direction were vistas of indescribable beauty—the glistening river winding through green cottonwoods far below us, tiny clusters of adobe houses gilded by the setting sun, the long, dark, rocky mountain spurs jutting out into the dusty plain. This was the border of Tarahumara land—behind us lay the future, before us the prehistoric past.

Early the next morning we were again climbing. The grade was the steepest we had ever encountered, and the jeep was kept in compound most of the time. Only powerful logging trucks or cars with extra low gears could hope to maneuver that awesome road. As it topped wooded hogbacks and dipped into grass-filled saddles it was bordered on one side by pine-clad, cloud-topped peaks and on the other by precipitous rocky chasms. All morning we ascended through a paradise of cool woods, between tall pines and amazing *madroña* trees with blood-red trunks. In many places the ground was covered with yellow violets, columbine, and mariposa-like lilies. We crossed the Cumbres de Gato divide at about 8500 feet and began a gradual descent into the very heart of the Sierras.

Midafternoon found us at the

head of a narrow, grassy canyon not far from the town of Guachochic. As we began unloading to make camp for the night, we noticed a column of smoke rising from the woods bordering the canyon. Thinking it might be the beginning of a forest fire, I went off to investigate. But it was only an old Tarahumara burning stumps in an effort to clear the ground for a little patch of corn. After we had greeted each other, I asked if he lived close by and whether there were other Indians in the area. His answers were so vague that I had to give up and asked instead if there were Mexicans near by. Oh yes, on down the canyon. I returned to the jeep, and we drove off to look for the ranch which must lie below us.

The old man had been correct, for we were soon stopped by a log fence, beyond which stood a low ranch house. While we debated our next move, two men suddenly stepped out of the brush along the fence. As they obviously wanted to know who we were and what we wanted, we hastened to explain that we were schoolteachers collecting snakes and insects for a museum and looking for cave-dwelling Tarahumaras to photograph. That is one thing about Mexico: a doctor, priest, or teacher is respected and trusted by the great majority of Mexicans. They seem to place more emphasis on *how* one makes a living than on *how much* one makes. As there is virtually no law in the almost unpopulated Sierra, a stranger must expect to have his presence questioned, and on more than one occasion we have been thankful we could claim as innocuous a profession as teaching. After a round of tequila, one of the men invited us to spend the night.

The field-stone ranch house was built around a large patio, and over the entire establishment was a roof of shingles. We later learned that all the beams, shingles, and even the wooden nails were hand-hewn by the Tarahumaras. We unloaded our bedrolls and were given a saddle room to use. By then it was dark and, as there was no electricity within a hundred miles, we



▲ ANTONIO CRUZ was fascinated by the author's photographic album and recognized some of his friends from the Sierra

➤ WITH NOTHING except an ordinary penknife, this violinmaker produced the instrument he holds, but he could not play it



prepared supper by the light of our gasoline lantern. Just as we started to eat, someone from the kitchen brought us a stack of hot *tortillas* and half a fresh cheese. After our hosts finished supper, they came to the saddle room to chat. In our limited Spanish we told them about ourselves, showed them magazines in which our photographs were printed, and explained about our interest in the Indians. When we finished, one of the men told us that in the caves of this very canyon lived 300 *Indios* and promised to take us on a tour of the accessible caves in the morning. We had found the Tarahumaras!

We awoke early. The air was cold, the sky cloudless, and our canyon still lay in deep shadow, for the morning sun had only begun to gild the sentinel-like pines on top of the western wall. By the time we were ready to set out, the entire canyon floor was drenched in warm sunlight.

Threading our way down the canyon, we noticed a small patch of corn growing near the base of a cliff to our right. Turning off the trail, we soon found ourselves in front of our first Tarahumaran cave. A great overhang formed the cave proper. Its sloping roof was black and sooty from decades of resinous pine fires, its wide entrance partially blocked by a low post paling. In front of the cave, at the edge of the maize patch, was a large wooden loom. An old Tarahumara woman sat on the ground before it, weaving a blanket of dark wool. Watching her were two Indian men. We asked how long she would need to complete the blanket and were told about two weeks. Most Tarahumaran blankets are brown with two or three white or yellow stripes, but some are white with brown stripes. The brown and white are natural wool colors, the yellow is made from a local species of lichen. Almost the entire scene before us was prehistoric—the ground loom, the baskets, the men's breechclouts, the cave, and the maize were all in use by these Indians before the fateful arrival of the white man.

Down the rapidly narrowing can-



▲ WHEN ASKED HIS AGE, this venerable herbalist said, "We do not count the years." He carried a bundle of pungent herbs, recommended for a multitude of ills, and peddled them in the local markets

yon we went—on and on between gigantic, monolithic boulders, over fallow-lying cornfields, past the gaping mouths of old abandoned caves. Below a towering, pine-topped cliff we came upon a tiny *milpa* (cornfield) in which two dark-skinned, white-clad figures were working. Behind them in the base of the rock wall were their smoky caves. Here primitive man and his environment were to be seen in their true perspective; insignificant, puny man adapting himself to unchanging, dominating Nature.

Finally, we entered a thick clump of low pines, and after threading them for a few moments we

emerged onto a bare, rectangular, floorlike space. The single wooden cross in the very center proclaimed it a Tarahumaran dancing patio, the Indians' only church, the scene of alfresco prayers to the gods of the Sierra. Our host and guide informed us that today was the day of the Rain Dance and that by late afternoon small groups of Tarahumaras would be dancing and chanting for the desperately needed rain in front of every *milpa* in the entire canyon.

Beyond the sacred dancing floor were several figures hoeing the knee-high maize. One was an old man, naked except for breechclout; the others were his wife, his two sons, and their respective wives

Continued on page 430



▲ SNOW GEESE traveling the great Pacific flyway find a welcome spot at Malheur

# Malheur Bird Refuge

This Oregon sanctuary is the home of a million water birds

By GRACE V. SHARRITT

Photographs by the Fish and Wildlife Service

A bufflehead flies up from a pond beating swift wings against the Oregon sky. In quick succession a honker, a canvasback, and a mallard rise excitedly from the marshes. Multiply these and other species by thousands of their kind, and you have a fast-action, real-life picture of Malheur Bird Refuge, home of a million birds, on a brilliant October morning.

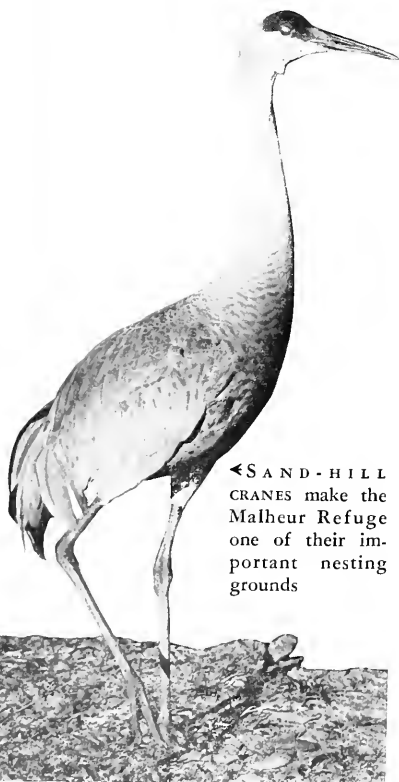
The air is a crescendo of wild song. Geese (Canadas and snows) call their indescribable, haunting cries, indicative of marshes and winds and wet earthy pungent scents. Ducks answer from reeds and rushes. Long-billed curlews, gulls, and cranes contribute to the general, beautifully deafening concert, with scores of red-winged blackbirds, killdeers, and sandpipers joining with lighter grace notes.

You become dizzy with sound—a joyous sound that is like a rhapsody of music to those who love the out-of-doors. It seems like unrehearsed music, in perfect counterpoint, a song about an America still beau-

tiful, still magnificent, with its mountains and rills, its deserts and plains, rivers and lakes.

As thousands of birds maneuver wings against the water and reach for the sky, the music increases in cascades of volume. As you listen and watch, the sun becomes clouded with birds, and you are reminded of early American tales of times when passenger pigeons choked the skies and game of every description crowded the landscape.

You take a deep, deep breath. You pinch yourself. You want to shout, "This is a wonderful land!" The past years of war, the troubled atomic present, the bewildering



◀ SAND-HILL CRANES make the Malheur Refuge one of their important nesting grounds



▲ UNDRAINED MARSHES provide food and cover for many kinds of wildlife in the Malheur Refuge, 20 miles south of Bend

future—all are momentarily swept away in this primitive feeling of birds and sky and water. This has permanency. This has roots. The grassroots of earth.

"And," says John Scharff, manager of the largest waterfowl refuge in the world, above the din of geese, ducks, coots, and shore birds, "this is just a fraction of the entire bird population of the refuge."

You can readily believe his statement, considering the small size of the lake in relation to the entire 175,000 acres of the area managed primarily for waterfowl by the Fish and Wildlife Service of the United States Department of the Interior.



▲ CANADA GEESE are nesting in increasing numbers since the Malheur Refuge was established, 40 years ago. In 1936, the area was enlarged through purchase of the Donner and Blitzen River valley, which feeds Lake Malheur from the south

For there are miles of dikes and innumerable ponds, marshes, and lakes balanced with sufficient grasslands to provide ample food, nesting places, and shelter for the hundreds of thousands of birds seeking a protected livelihood on this western bird-airway known as the Pacific flyway.

Malheur Refuge, located in sage lands of Oregon's grazing empire about 35 miles south of the town of Burns, is only one of a chain of 291 wildlife refuges established for big game and birds by Uncle Sam, throughout the United States, Alaska, Hawaii, and Puerto Rico. These refuges give heartening vindication to the foresight of Theodore Roosevelt and others who years ago led a solemn program to save America from complete spoliation by selfish exploiters of our country's forests, waterways, lands, and minerals.

Forty years after its establishment, Malheur Refuge is now one of the most important nesting grounds of the Canada goose in the United States. Because of its strategic

location nearly midway in the great Pacific flyway, it is estimated that over 6000 geese and almost 100,000 ducks meet the world for the first time each year and are raised to maturity in this remote valley of the Steen Mountains. The past year's birth rate jumped to approximately 130,000, with red-heads and mallards leading the census figures.

Much of the grasslands of the 270 square miles of the Malheur area is used for grazing some of the finest white-faced and Angus cattle in the West. A question often posed by wildlife sympathizers is whether the cattle interfere with the productivity of the nesting birds. Mr. Scharff, who is a keen observer and a student of wildlife conditions, claims that rank meadow growth, uncut and ungrazed, affords very limited grazing for geese, while mowed meadows offer ideal conditions for the feeding of these birds. As if to substantiate his theory, it is a common sight on an autumn day after the meadows have been mowed to see hundreds



on. Visitors are welcome, but birds must be given first consideration throughout its 175,000-acre area



of geese and cattle grazing contentedly together in the same field.

Upon the grasslands also, several thousand sand-hill cranes enjoy an abundant living. These huge beige-feathered birds with red skull-caps and bustled behinds look like hang-overs from some distant era. Many ornithologists and naturalists travel thousand of miles just to glimpse them at home in Malheur, which is said to be one of the most important nesting grounds of the sand-hill crane in North America.

Although Malheur has been especially developed for migratory birds and waterfowl, other species of wildlife also find protection here. At present there are large herds of antelope and deer, and beaver are increasing in great numbers along the Blitzen River.

An experiment in breeding the rare trumpeter swan is also part of this refuge's plan. Young swans, or cygnets, have been transferred from the Red Rock Lakes Trumpeter Swan Refuge, in Montana, in the hope that this waterfowl, once almost extinct, may become more secure.

Visitors are welcome at Malheur but with the understanding that they provide their own transporta-

tion. The birds, of course, take first consideration. No tours are allowed that will in any manner disturb the wildlife. Nesting reaches its peak in June, and chances cannot be taken with 130,000 baby ducks and goslings seeing the world for the first time, not to mention the fledglings of the scores of different kinds of smaller insectivorous and seed-eating birds, as well as rails, ibises, stilts, and willets.

At the southernmost end of the refuge the settlement of Frenchglen, with its country hotel, service station, and general store, offers modest but comfortable facilities.

Perhaps to the casual observer driving along the Oregon highway, the approach to the home of a million water birds may prove disappointing, with its discouraging miles of bad roads and rather monotonous landscape of sage and rocks and greasewood. But these discomfitures, if you call them such, are the natural barricades protecting the wild residents from human curiosity. Isolation is paramount.

It is because of this isolation and these natural barricades and the constant vigilance by the Malheur staff, that you can hear, on a morning any time from spring through

late autumn, the wild songs and cries from a million feathered throats. It is also because of these protective measures that you are privileged to witness the enchantment of thousands of birds in varying colors and shapes and habits, from the long-legged avocets with spearlike bills that turn crazily up instead of down, to the diminutive marsh wrens caroling insistently from reeds and rushes like an orchestra of zithers.

It is then, when you see and feel and hear this miracle of wild music, this saga of the grassroots and skies and waters, that you feel your America is basically good and sound and great. And although the future is still confused and often dark with doubts and despair, you can gain refreshment of mind, new hope, and a lift of the spirit in the assurance that places like Malheur Migratory Bird Refuge are preserving some of the things that link us to the eternal scheme of nature.



▲ LARGE COLONIES of avocets breed at Lake Malheur



◀ ANTELOPE and other animals also find sanctuary in Malheur's 270 square miles.

In these ways, Malheur and almost 300 other federal wildlife refuges help to preserve our natural America against destructive exploitation



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# DOWN TO EARTH

Philip Gendreau photo

The few who have pleaded and worked for Conservation have not been heeded by those who would cash in and clear out. Now our food supply is threatened, and it is essential for every citizen to know the basic ills and remedies

By C. H. CURRAN

*Curator, Department of Insects and Spiders,  
American Museum of Natural History*

IT is unfortunate that so many people look upon conservation as an effort to save the last remaining few of some kind of animal or plant seemingly on the verge of extinction. One reason why this aspect of conservation is so often brought to the attention of the public is that it makes good newspaper copy. Actually, it represents only a small (though important) segment of the field. The full field of conservation really concerns every man, woman, and child in America—and more especially the children

—because it is they who must suffer as a result of our negligence. Conservation is concerned not only in preserving what is left of the rich heritages left by our forefathers but also with the rebuilding of the lands and forests and other beauties of our country.

Few persons realize that the great prairies over which countless buffaloes roamed only a century ago—grassy plains that later supported great herds of cattle and sheep and then, under intensive agriculture, became known as the “breadbasket

▲ FIRE IS A PERSONAL PROBLEM, because it can be prevented only by personal vigilance. Fire is a public menace, because it destroys resources essential to our nation

of the world”—have largely deteriorated to a condition not much better than that of a desert. The productive areas have shrunk at an alarming rate and are still shrinking. This rich region will soon be so depleted that it will no longer produce enough grain to provide bread for the people of the United States.

The sequence of events leading to this present condition has been repeated many times in many lands. Two thousand years ago the land of Canaan was “flowing with milk and honey,” but it became a veritable desert long before America was discovered.

There has been much condemnation of the virtual extermination of

the buffalo. Obviously, there was terrific slaughter of these grand animals, almost all of it senseless and very little of it sporting. The buffalo held its own against the Indians, who killed only for food and clothing, but from the first day that the white man set foot on the prairies, the buffalo was doomed. Grazing cattle and the buffalo could not exist together, and since man favored the cattle, the outcome was a foregone conclusion.

While the cattlemen held sway the prairies held their fertility. The short-cropping sheep that were brought in almost at the same time as the cattle did some damage, and there was much antagonism between the sheepherders and cattlemen, but the sheep were not so numerous. Following these came

the wheat farmers, who obtained great crops from the rich virgin soils. When the soil became depleted, many of these farmers moved on to new land, and mixed farming—cattle, corn, wheat, oats, rye, and vegetables—replaced the wheat farmer. These farmers did fairly well because they fertilized the soil and because they learned to rotate crops in order to replace some depleted elements. But in huge areas of the prairies there was little moisture to begin with, and when the moisture-holding humus was exhausted or seriously reduced, the vegetation became so depleted that the surface soil blew away, producing the present Dust Bowl.

Around the Dust Bowl is a broad band with barely enough vegetation to hold the soil, and outside

this is a marginal farming area. On these farms a meager and hazardous living can be made. In years of severe drought there is no crop, and two or three such years may add another tract to the Dust Bowl desert.

The conservation of these marginal farm lands is a problem of great concern. It does not matter what grows on them; there may be a wide variety of plants, including normally unwanted weeds. The important thing is that the plants preserve what humus is left and thus prevent erosion by wind or rain. The reclamation of these areas will be a long and tedious process. Man has destroyed in less than a century what it took nature hundreds of years to build. But it is not impossible that man and nature working together can rehabilitate these areas in a few hundred years at most. If special grasses and other plants can be found to carpet the soil with green, success is assured. Conservationists believe that with proper experimentation and planning this can be achieved. If man also learns to retain what has been rebuilt, the food supply of America will be virtually assured.

Something of the utmost importance has already been learned. It was long known that the seeds of buffalo grass became fertile only after passing through the digestive tract of the buffalo. As a result of extensive research it is now possible by chemical treatment to make the seeds of buffalo grass grow where there are no buffaloes. Since this grass resists drought and holds the soil in place, it is ideal in any pro-

*Philip Gendreau photo*



▲ **OVERCROPPING** produced the Dust Bowl, not just freak weather. The overworked soil lost its power to support a protective cover. Result: a land-sore that will continue to spread unless nature is aided toward recovery

➤ **RICH AND PRODUCTIVE**—if not pushed too far. It is hard to realize that areas in the Dust Bowl looked as fertile as this a few years ago. Fertilizer, rotation of crops, and protection of the exposed topsoil between crops could have kept it so

*Keystone View Co. photo*



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View Co photo

Black Star photo



Ewing Galloway photo

Parma photo from Black Star

◀ **CONTOUR PLOWING** leaves level furrows that hold the rain and prevent soil erosion. Planting different crops in alternate strips also permits staggered harvesting and avoids exposure of whole hillside to erosion at one time

▼ **AERIAL PHOTOGRAPH** showing scientific soil conservation program employing strip planting, in Clayton County, Iowa



needed. In such cases the swamp must be recreated if pasture land is to be reclaimed and milk and beef produced—with mosquitoes also present!

The fisherman, sportsman, camper, and farmer are all pestered by mosquitoes, black flies, and other biting insects. They could all enjoy life much more without these pests. But the fisherman, especially, would suffer if we did not have these or other insects to take their place. The basic food of fresh-water fishes is insects, smaller fishes, and other small animals. Insects are the most essential, and mosquito and black fly larvae constitute an extremely important part of their diet. The

Herbert C. Lanks photo from Keystone View Co.

gram for reclaiming the Dust Bowl. The problem is to produce enough of it and to induce sufficient interest to encourage its use on a scale large enough to produce appreciable results.

In our efforts to produce ideal conditions for living, we often make changes that carry the very seeds of our destruction. Almost everybody agrees that the elimination of mosquitoes would make things more comfortable, and the destruction of certain kinds would eliminate malaria and other diseases. One phase of mosquito control is the draining of fresh-water swamps and ponds. This is one of the surest ways of eliminating breeding places of many, though not all kinds, of mosquitoes, but at the same time it may have a harmful effect on the whole countryside. One of the chief requisites for the maintenance of plant growth is the proper amount of water in the soil. Some plants can stand more than others. Certain swamp and pond plants need to have their roots continually saturated. Not all semi-aquatic plants, including trees, die when a swamp is drained, but many kinds are completely eliminated.

The disappearance of the plants is not the only result of draining operations. The influence of the swamp or pond extends far beyond its visible borders. With the draining of many swamps it has been found that adjacent pasture lands have dried up, so that where we once had lush grasslands only the bare soil is now in evidence. The water that had been conserved in the swamp to take care of drought conditions was not there when



▲ **SOIL EROSION** that will spread rapidly unless the exhausted earth is enriched and protected by suitable growth during its convalescence

fishes either eat them directly or depend upon other creatures that feed upon them—larger insects, tadpoles, frogs, and other animals.

One does not expect to find fishes in swamps; few look for them there. However, many swamps have an amazingly large fish population. During spring floods small fishes may become stranded in swamps. I have seen five-inch perch living in a small water hole on the side of a hill fifty feet from the edge of a lake. Their only chance of returning to the lake would come with heavy rains that would produce a stream.

I do not wish to imply that mosquito and black fly control should be abandoned but merely to point out that unless any control program considers every possible angle, it may do much more harm than good. And now that we have available several very excellent insect repellents the need for control in fishing areas is greatly reduced. The farmer has available several DDT products to protect his cattle, as well as other preparations with which to kill pests before or after they enter his home. The cost of personal protection is small, while animal protection more than pays for itself by increased production.

At Bear Mountain and Harriman State Parks we have clearly demonstrated that proper spraying of both open and closed buildings will permit campers to sleep in absolute comfort. Only two or three swamps in the control areas have been partly drained, and a few pools are sprayed with plain kerosene. No effort is made to control pests in wild areas (the camper must use repellents when in them), and as a result there has been no interference with the development of plants and animals in their natural surroundings.

While the Dust Bowl is the best-known American example of the destruction of productive land, most persons do not realize that there are hundreds of thousands of acres of land in other parts of North America that have been leached of their fertility. These acres, in the form of abandoned farms, are mute reminders of the struggle of the

early pioneers to make for themselves a better living than could be found in Europe or in eastern areas where the fertility of the land had been lowered through years of cropping.

When the lands were first cleared, the timber furnished a limited income, and the rich surface soil produced abundant crops. These pioneers worked hard to earn a modest living, and many of them were not farmers. It is no wonder that, as the years went by, productivity decreased and the yield necessary for subsistence could be increased only by farming a larger area.

We have no reason to shake our heads and blame our ancestors. They worked hard to keep alive and save a few dollars a year for their old age and to provide for their children. We cannot blame them for growing the crops that best provided for their needs—wheat for themselves, oats for the livestock, and peas, corn, potatoes for themselves, their pigs, and their chickens. Each of these crops was grown on a field that was known to produce the best results. Unfortunately, the main crops—wheat, oats, rye, and corn—all take from the soil practically the same elements, but this was not known until late in the nineteenth century. Only during the past 75 years has farming become a science, and for a much shorter time than that has scientific farming been at all extensive. Rotation of crops—cereals, potatoes, and legumes—has done much to build up or maintain soil fertility, but it has not been practiced enough to prevent moderately fertile farms from becoming borderline. The automobile and tractor have not helped to maintain farm fertility. The farmer who once owned two or more horses and one or more cows may not own a single draft or milk animal, and fewer farmers keep pigs. All this results in an enormous loss of natural fertilizer, and, while the chemical fertilizers furnish many of the elements needed in plant growth, they are utterly lacking in the organic materials that make rich humus.

It may seem that these worn-out farm lands and the borderline farms

where people can still eke out a scanty existence (the abandoned farms of tomorrow) have nothing to do with conservation. Actually, they should be the deep concern of all serious-minded citizens. Obviously, it may be hundreds of years before these lands can begin to approach their original fertility. Before this point can be reached we must learn about the "trace elements," those plant foods that occur in minute quantities in the soil but are essential for the production of healthy and maximum crops and forests.

Reforestation plays an extremely important part in conservation. However, it is still beset by many problems. If the land is left alone to produce a natural forest growth, there will follow a succession of dominant trees, and scientists are learning what the sequence will be in any given region. But when it is desired to produce revenue in a long-range program, conifers are most frequently planted if the land is suitable. The trees are set out rather close together on the theory that each alternate tree will be removed in time. All the trees will then grow with straight trunks and with few if any knots, because the lower branches will be killed by lack of sunlight. This is both good theory and good practice, but unfortunately in many cases the practice is not carried out. The result is that the superabundant growth in a limited area produces spindly and often unhealthy trees, because the food supply is insufficient when they get older. In the case of spruces, balsams, etc., used for Christmas trees, thinning can be quite profitable. Trees of a height of five to fifteen feet can be cut out over a period of years, resulting in the more rapid growth of the remaining ones.

Among the common practices once used in the clearing of land was the burning of brush. There were several different kinds of brush burning. The rich, black bottom lands in the valleys and many of the prairie lands of the West were covered by small trees and bushes. These were generally cut in the late summer and fall and



Keystone View Co. photo

◀ **AREAS OF DESTRUCTIVE LUMBERING** always stand in stark contrast to adjacent lands where effort has been made to conserve the forests or treat them as a sustained crop. The exposed marginal zone is in danger of becoming part of the wasteland

▼ **GUARDIAN** of the public trust: a ranger in Yellowstone National Park. Only as long as our citizenry holds our national and state parks sacred can these areas be effectively protected by their custodians

burned late in the winter. This caused little damage to the soil, since the humus was not burned out. Where lumbering was practiced, the slash was often piled on top of stumps in order to burn them out. However, where lumber was the sole harvest, the slash was often left for years and became tinder, so that when a fire occurred, it burned deeply into the soil and frequently ruined the land.

In the great timber belt extending across Canada many forest fires were welcomed. This great area, the largest outcropping of Precambrian rocks in North America, known as the "Precambrian shield," contains untold mineral wealth. The covering of soil in most parts is very thin, and in many places the forest trees have a precarious existence. They are mostly evergreens and now furnish us with most of our pulp for paper, but poplars, birches, and willows, none of any great commercial value, abound. When these are burned off, the rocks are stripped bare, and forest fire areas become happy hunting grounds for prospectors. Several of Canada's rich mines have been discovered in the wake of forest fires.

Burning was used for other purposes, too. The Indians of certain areas burned over rough ground because within two or three years blueberries and huckleberries sprang up in abundance. The practice is outlawed, but it probably continues today. I have known of several fires set for this purpose by



Philip Gendreau photo

farmers who relied upon the berries as part of their annual income.

Soil erosion is the greatest enemy today. Once the forest or other protective vegetation has been removed, there is nothing to prevent the soil from washing away or blowing away during excessive dry periods. Just how serious this problem is may be gleaned from the statement of Representative B. F.

Jensen of Iowa, who told a meeting of the Mississippi Valley Association, last January 16, that "about one-fourth of the nation's crop land is rapidly being damaged by erosion and that much of it is in danger of being permanently damaged." Other speakers at the meeting expressed the fear that the "Marshall Plan" is endangered and that the nation will have difficulty in feed-

Continued on page 429





▲ MANY LIFELIKE FIGURES can be discerned in the intricate carvings of the cliffs, making this an unreal world of memorable natural spectacles

Rudolph Hagen, who, through marriage to a woman who was homesteading a large part of what is now called Red Rock Canyon, became the owner of most of this unusual section of California scenery. Efforts have been made by Kern County officials to buy the area, with the thought of its becoming a National Monument. These attempts, however, have been unsuccessful,

and ownership still remains with the Hagen family.

While most of the inhabitants were mining, one woman with considerable initiative had another plan. In those days it was not known that most of the springs in the region were tainted with arsenic. This woman, reportedly of Spanish descent, found not far from Sullivan Spring a good spring whose

waters seemed to have a very tonic effect. As the story is told, she had dreams of developing the spring and even of bottling the water and selling it as a great cure-all for humanity. She did construct a tunnel some distance back into the cliff, but what happened to the woman is lost in oblivion. Water still stands several inches deep from wall to wall, but no one drinks it.

Carpeting the floor of the canyon in the spring are gay masses of bright-colored mimulus, lupins, gilias, and innumerable other species of desert flora. Scattered stands of the Joshua tree lend the elegance of their regal blooms, while some weeks later brilliant "bouquets" of golden yellow casia enliven the landscape. Although spring is most varied in hue, late summer and fall are gaudy with the bright yellow of the rabbit brush, which grows to two or three feet in height.

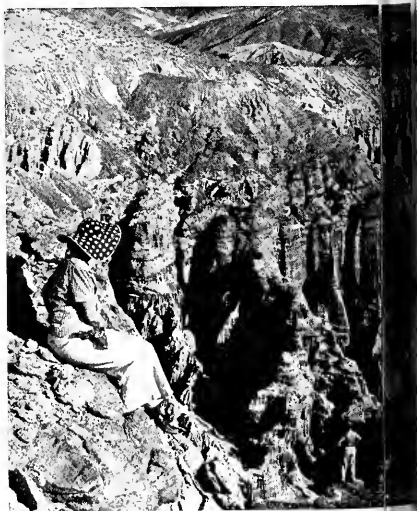
Not much wildlife is apparent by day, but innumerable trails and holes tell of an active night life. A cute little fellow observable in the daytime is a miniature antelope ground squirrel. His white tail curled over his back reminds one of a chipmunk, but his stripes run

► OLD MINE SHAFTS, derricks, and miscellaneous equipment dot the landscape. More than \$16,000,000 in gold has been taken from the Red Rock Canyon area. The old stage road winds up a tortuous trail out of the gully, in the background at extreme left



◀ THE ENTRANCE to the old Spanish woman's arsenic spring. With visions of a wide market for her "medicinal waters," she had tunneled back into the mountain for some distance to get a good flow

▼ FROM THE CANYON RIM: a dramatic view of the work of erosion in the Magic City sector of Red Rock Canyon

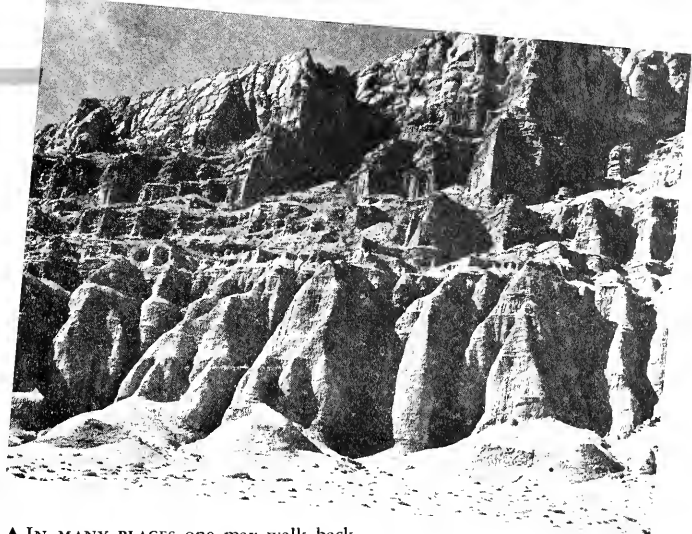




only to his shoulders, not to his nose, as do those of the chipmunk. Ravens cawing raucously from the crags are the most noticeable birds, but if you camp by the cliffs at night you may hear the notes of the saw-whet owls nesting in wind-swept holes in the rocks.

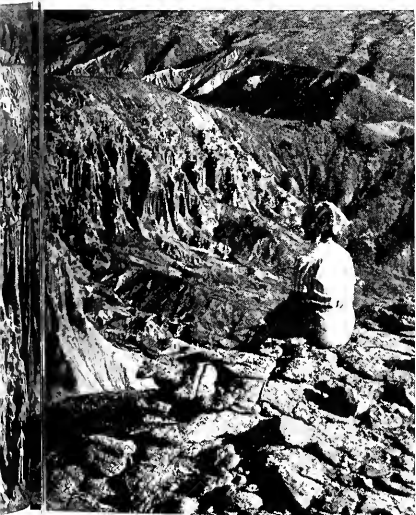
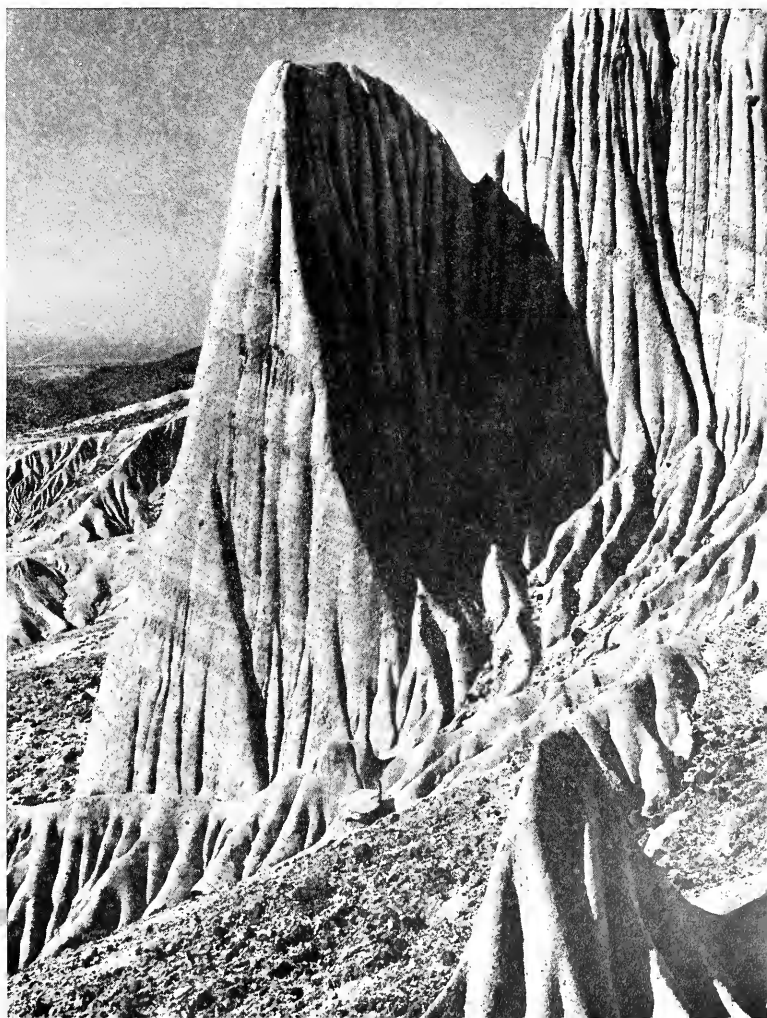
But the most important thing about the canyon is not its history or its flowers and animals. It is the losing fight its massive, turreted battlements are holding against the forces of erosion. Formed of comparatively soft conglomerate rock, the life of these cliffs will be short geologically. In many places slip-pages are easily discerned in broken lines of strata or in masses protruding beyond the wall and held in place only by the fallen rubble below. Floodwaters swirl around the bases of high precipices, wearing away the foundations, until finally the weight above forces mighty walls to drop.

High on the mountainsides, however, new formations are continually eroding into view. Thus the canyon continues to renew its fantastic beauty despite the rapid forces of destruction. Excluding Bryce and Grand Canyon, Red Rock Canyon is one of the greatest erosion marvels of the West, and it deserves to be preserved as a National Monument.



▲ IN MANY PLACES one may walk back amid the colorful formations into carved niches and caverns. Occasionally an abandoned prospector's hole may be found

▼ THE PLAY of light and shadow shows how exquisitely nature has carved the rocks



RED ROCK CANYON



Part II of an article in three installments

◀ THE CRESTS of Snares penguins are yellow, the eyes red, the beaks brown-red with a pink edging, the backs and flippers steel-blue, the fronts white, and the feet pink. These penguins stand about eighteen inches tall

would catch and climb up the cliffy slope, sometimes they would fall back into the terrific undertow of the powerful surge. They would try again and again until they made a landing by using their strong feet and their flippers. Then they waddled off, clean and sleek and sure, as if they had not taken a beating that few animals could live through. They must enjoy the battle, or they would swim to quieter waters where they could land in peace.

Gales drove the rain across the strange forest that covers much of our island. No branch obstructs their sweep. Coarse, heavy, but beautiful leaves lie on one level,

THE aeon-long night passed. At half-past four a little light came in through the door of the windowless hut. Enough men had stirred so that Bob and I could climb over the scrambled legs. Charlie Fleming, our geologist, helped me with a good strong hand.

As we stood upright outside, Bob said excitedly, "Look, the Cove!" It was a boiling cauldron of breaking waves. "Alert" would have been dashed to tinder had she stayed. The long, wide strands of kelp, ranging from darkest brown to golden tan, were churned and twisted and brushed on and off jagged rocks as the waves washed them every which way. It seemed to emphasize the fact that we ten were alone on an empty island, not knowing what storms might hold us there.

Alone? Of course not: Bob and I sat on a pinnacle of rock above a raging sea, watching the penguins. The biggest waves, so big and angry no human being could survive them, rolled penguins in by the score. Sometimes the hardy birds

## A Naturalist's Wife

Life on a scientific expedition as viewed by the only woman ever to land on the lonely and unexplored Snares Islands, south of New Zealand

By GRACE E. BARSTOW MURPHY

Photographs by ROBERT CUSHMAN MURPHY



➤ THE AUTHOR and her friends

close-growing, almost as evenly laid as a man-made roof. This forest is undulating, smooth-flowing, like the grass-grown hills above the tree line back in normal climates. Were this not so, the gales would tear the leaves to ribbons, as I have seen our two great hurricanes do on Long Island, where gales are not expected. The trunks, too, have habits adjusted to the gales, for they lie half supine along the muddy ground. If they tried to stand up straight like other trees, the weight of the wind across their tops would break them down. Penguins march among them to their rookeries, and great, sluggish sea lions wallow in the mud, though they prefer the few open spaces to the shade of trees.

When the others finally woke, Bob and I had our first lesson in the science of camping in mud. The



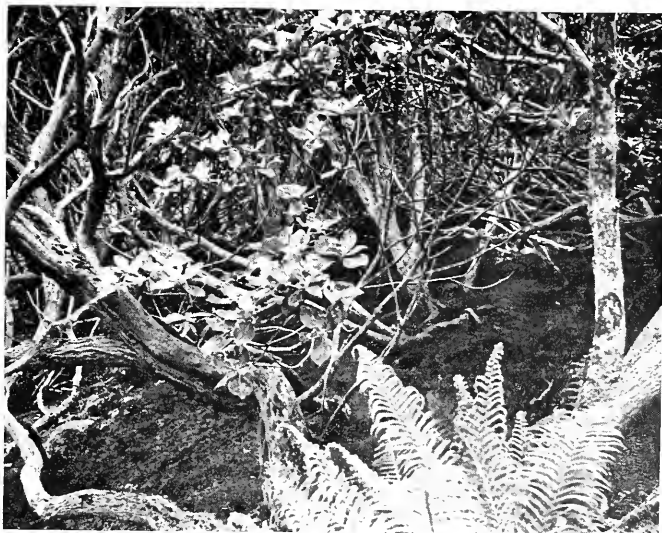
▲ NO PROTRUDING BRANCH obstructs the gales that sweep across the undulating Olearia forest. The new spring leaves are silver-gray, looking like candles among the older, darker foliage

## in the Sub-Antarctic

whole island is deep, oozy mud. It is under the trees, around each clump of tussock grass, everywhere. No one at home ever saw such mud. It is dark and squashy and slippery. We wear high leather or rubber boots all the time. We slip and fall in it. Its only good quality is its softness, which breaks the very fall it causes.

"South Georgia was never like this," said Bob. "Of course there was mud, as there nearly always is where there are penguins, but there was plenty of dry ground and plenty of clear, fresh water."

▼ IF THE TRUNKS of the daisy trees were upright, they could not stand the weight of the gales. The forest floor is mostly deep, dark mud, into which all slipped and fell



◀ ROLAND AND HUGH cut the heavy fern fronds for flooring the tents, but the mud oozed through





◀ THE HANDSOME SKUA is a pirate, fearless and ruthless



▼ ADULT PENGUINS herd the babies into nurseries, as hopeful protectors against the predatory skua

The "fresh" water here is mahogany brown and smells so horribly of penguins and sea lions that not even the hardiest man would wash a finger in it.

There was not a level spot for the tents. We could not set them up by the landing because of the sea lion wallows and the gale's sweep. Above the high grass hummocks rose the forest in a fearful mass of great trunks and tangled branches, all moss-covered, reaching out close over the underbrush of — mud. Big ferns, stumpy things with long fronds, somewhat softened the horrible medley of the massed trees.

The efficient New Zealanders finally chose the edge of the bush. Ground was partially leveled. Great, heavy fern fronds, six feet and more long, were piled inches deep as flooring. Four commodious sleeping tents went up near each other. Our supplies were brought for us by the others of our party, and included thick, white blankets Mr. Stead provided. Their whiteness did not last! Bob Falla has a single tent near Bob's and my big double one. Mr. Stead and Major Wilson are reveling in luxury with mattresses on their cots. Roland Stead and Hugh Richards have settled into very neat housekeeping. Farther up the hill Charlie Fleming, Mr. Newcombe, and Mr. Baird have a large round sleeping tent and a little tent for their instruments. The castaways' hut harbors collections. The mess tent, built by the Major and the boys, is a work of art. I am writing at its long table, which



is flanked by benches. There is a fireplace at one end for cooking, the pots hanging on S-hooks. Crates of food line the sides. We take turns with the work and are having good, hearty meals. The warm wood fire is a blessing.

Each morning we breakfast on fried muttonbird eggs. Each one is larger than two hen's eggs. We are not robbing the birds, for only those laid deep in the burrows are incubated. During the early part of the nesting season, the birds can't always wait, so they lay their eggs outside, just as babies get born in taxicabs before reaching the hospital. I have picked up these doomed eggs on the path to our tent, for the muttonbird burrows are everywhere, all over the island. At dusk, one may stroke the soft gray of these beautiful petrels as they squat outside the openings of their burrows.

This path that I speak of is, of course, mud. The boys fill it now

and then with fern stumps, which help till the water finds it can ooze up almost as well as without them.

Bob and I did not know the ropes about flooring, nor did we have enough bedding. The tent floor was a bog. We froze in our cots. I told Roland and Hugh and asked for some of the big fern fronds to put under our sleeping bags. Instead they broke out the castaways' casks, with the result that under my sleeping bag there are six complete sets of men's clothing, including heavy underwear, of the vintage of my grandparents. The cloth of the suits is a very gay check. Bob has extracted some of the castaways' underwear and has put it on. I may succumb to the same idea if I shiver much more. Most of this clothing will be sent later for European relief—to war castaways. We also found heavy boots in perfect condition and an iron teakettle which would make a Madison Ave-



nue antique dealer quite covetous.

Mr. Stead has been asking how I have been standing the mud and if it was repulsive to me. I told him I hadn't time to worry over it and that Bob and I helped each other dress till we got our boots on and could stand up in it. The boys gave us a potato sack which makes a very good rug.

There is a colony of penguins between Bob Falla's tent and ours. They march past our tents all day. They keep up an endless chatter, so that at night the din of penguins and muttonbirds is fearful. The latter, in their burrows, sound like millions of crying babies. Some of the penguins are nursing their big chicks, which are covered with dark gray down, making them look as large as their sleek parents. Narrow flippers that are not feathered cannot successfully cover chicks, but the urge to cover them is the same as with feather-winged birds. The parent pairs are very affectionate, caressing each other with their flippers and even helping to scratch. One parent stood quietly with a flipper touching the breast of its mate, while the other parent was actively demonstrative. I am told the females are the aggressive ones. Sometimes a chick pushes between the parents, wanting food, but getting scant attention.

Down beyond the mess tent and up the hill beyond the hut, a small colony of penguins has been enacting exactly the same drama Bob saw in South Georgia long ago. Three adults, equidistant from each other, have been guarding twelve muddy chicks. Newly hatched chicks win a whole adult apiece, but older ones like these are graduated into nurseries. At this stage, the parent penguins do not overlook the advantage of having babysitters.

There is a skua up by the penguins, and I went up to watch the great, dark, predatory gull. The skua was hungry. Moreover, she had two chicks over the rise of the hill among the rocks, and they are always hungry.

The handsome bird walked round the penguin colony. Twelve penguins had herded their offspring in

a tight clump. As the gull approached, more nonchalant than she (or he?) probably felt despite her strength, the penguins stretched their necks and screamed at her. They were so excited they turned now and then to peck at the poor babies, like cross nursemaids in Central Park. The skua would walk up close but be driven back. Three times, on long, strong wings, she landed in the middle of the fright-filled group. She did not get a chick, though once she filled her bill with gray down, which she tried to spit out disgustedly. The chicks are big now, and their parents did not give the skua time to get a good grip to carry one off. When she finally left, the penguins settled down to rest, half nodding to each other in a well-that-is-over way. It is impossible not to dramatize penguins. One watches the crowds of people on New York streets and is wearied, but one never tires of watching penguins and interpreting their actions.

The skuas kept up their attack on my little colony, gradually getting every chick in it. The parents grew used to me, so that each day I walked close to their rain-bedraggled, muddy babies, whose bones

were soon scattered under their parents' eyes. Three disconsolate adults came to look at the deserted spot, and now and then a weak attempt has been made to live on it again. Building nests takes scant time, for they are depressions in the mud with a few sticks and stones.

A scramble over the rocks of several headlands brings me to a favorite spot on a cliff 100 feet above the sea, where there are penguins in thousands. They ride in on the highest, roughest waves of the cliff-dashing sea. Their main avenue, which we call Penguins' Broadway, stretches away over the hills, worn out of the black rocks. The coast is the wildest I have ever seen. The winds blow cold. Unknown centuries of plodding, little pink feet, each set carefully down after the other as would yours or mine be set on a steep path, have worn this wide way leading across the open tussock-covered hill to the rookeries. When there is a depression they jump across, both feet together, and when there is a slight elevation they jump up, measuring the distance accurately. Coming down such a path or on cliffs is not quite so easy. They slip and

▼ SNARES PENGUINS, after taking a beating in the powerful, surging waves, rest a bit before climbing to their colonies in the madly twisted forest



slide quite long distances. Sometimes they stop and perch comfortably on level hummocks or rocks. Sometimes they lie on their stomachs on almost perpendicular rock sides. I watched one high above me on a hummock, head hidden behind the flipper. He looked like a black kitten with whiskers showing, his dark steel-gray turned darker by the light.

The penguins seem to have four methods of progression: walking, hopping, swimming like ducks, and leaping like porpoises in the water. The hop is faster than their almost ludicrous walk, for their feet are so big and their legs so short they cannot get all of one foot in front of all of the other foot. As I sit quietly among them, I can watch all their habits, even to the flash of their transparent extra eyelids, which cross their open eyes every two or three seconds. When they grow sleepy, their eyes close or blink. At other times they are wide open.

A dignified penguin sat solemnly at my crossed feet the other day. We seemed to discuss many matters of interest. Getting restless, I uncrossed my feet, and my friend turned to leave. As instinctively as I would speak to you, my reader, I said:

"Oh, please don't go."

And he turned and stayed.

Beyond where I was sitting, between my rock and the next promontory, there is an almost level ledge, kelp-edged, nearly free of water at low tide but covered by a few feet at high tide. Here penguins have a playground. Some pour into the surf and are swept out to sea, while others are spun out of the pounding waves to struggle to dry rocks. One large group has a game of standing stock-still on the flat rock ledge waiting for a rousing roller. When it comes, it sends them tumbling and scurrying. As it recedes, they climb on the same rock again, awaiting the next. It is their kind of surfboard-riding. They play in groups at sea, too. They roll over in the water to polish their white shirt fronts and wash the mud off.

It is fortunate that penguins have the thick skins I help Bob prepare.

Their armor against the terrific buffeting on jagged rocks explains their survival. The coat of feathers is thick and deep, and the skin is tough. Under the skin is a heavy layer of fat like a fibroid mattress. It is my job to cut this fat off after the skins are roughed out. With scissors I cut off the hunks and partly clean out the skull. It is back-tiring work without a chair, yet as I say:

"Seeing a penguin inside out

Is something to write home about."

As everyone's back aches in our chairless, comfortless existence, no one bothers about one's own. Bob says it is the hardest living he has ever known anywhere in the world. There is a new puddle in the tent at the foot of Bob's cot.

There is never a level spot for two successive steps, and we all fall down in the mud so often no one ever notices it. Penguins fall forward, for their tails are supports. Humans fall backward. I took one backward tumble downhill, getting my hair full of mud, and there is no way to wash it. I am restless for a bath, yet would not cut this experience short an hour for the sake of one. Have any pioneers expected hot baths every day?

The whole place is so damp with the constant rain that it is hard to dry the bird skins, much less wet clothing. The branches of the trees feel muddy and damp.

Bob Falla told me that the island lies in the track of moisture-laden westerly winds that have blown over a wide expanse of ocean. I asked him why the warm ocean current which flows north in the Tasman Sea does not help. I see it on the map. He said:

"It would be much worse here without it. The current is not as strong as your Gulf Stream, and the life in it is not so interesting."

The New Zealanders take the edge off the hard living by their unfailing courtesy and their thought not only for Bob and me but for each other. When I have spoken of it, they call it their "training." That it lasts over into such camp-life as this shows how genuine and natural it is. They tell me that our

officers, marines, and GI's were very courteous and generous.

"Your men taught us Enzedders to 'say it with flowers and chocolates.'"

"There is your own courtesy again in your kindly judgments," said I.

"Of course, like our own soldiers, they had their boisterous fun at times," one said, and again I pointed out that including "our own soldiers" in the statement again proved their courtesy. So they began to tease:

"Do you want to take us all home with you?" Then a stubble-faced, unkempt, and unwashed gentleman took out a cigarette and asked me, as if we were in evening dress at a dance in 1910, "May I smoke?"

They are good company and merry, but their humor is different from our American brand. The boys built a pyramid of firewood which called for a banner on it, I thought. So I made one, using all our names in word play:

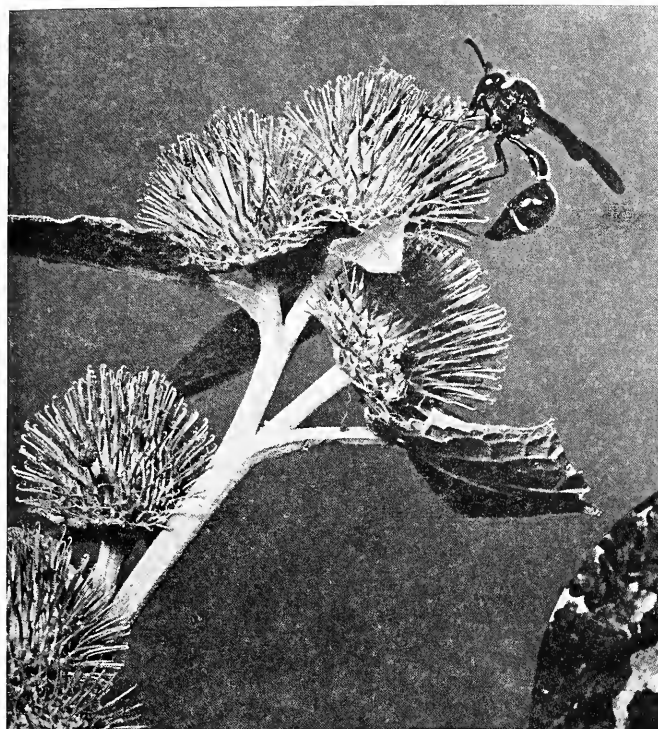
"Camp of the Trained Mud Turtles: This is a Major job done by the wit of New Zealanders, inSteAd of by Poor Potatoes of Americans. Newcombers will find that tents do not Falla down. The Bairds are comfortable. The Hughs of birds and trees are so beautiful they keep everybody Fleming in zeal for Natural History."

Bob Falla read it and waved to me merrily. Mr. Newcombe and Charlie Fleming waved. Hugh said, "Do you mean the Murphys by Potatoes?" Nothing else was said, and it disappeared without an American jab at going me one better.

Yet the difference between the Enzedders and us will always be the fact that, whereas Americans go camping with ten pounds of coffee, the New Zealanders take ten pounds of tea. There are no other differences that matter. New Zealand and American scientists match well, living together in the rain and mud on a stormy rock at the bottom of the globe.

The third and last installment of this article will be published in the December issue of NATURAL HISTORY.



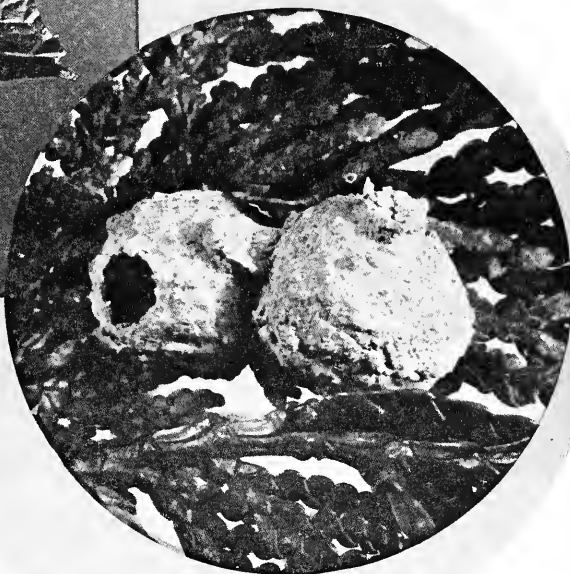


◀ THE POTTER WASP, *Eumenes fraternus*, which produces small jug-shaped nests and stocks them with caterpillars for her hungry larvae

By EDWIN WAY TEALE

Photographs by the author

▼ THE JUGS of the potter wasp attached to arbor vitae



# PIONEER POTTER

An insect master craftsman makes man's ancient art look young

**S**MALL yellowish or grayish objects, about half an inch in diameter, shaped like round jugs and cemented to twigs, are sometimes encountered among bushes and trees. They are the product of one of the world's pioneer potters, a narrow-waisted solitary wasp known to science as *Eumenes fraternus*.

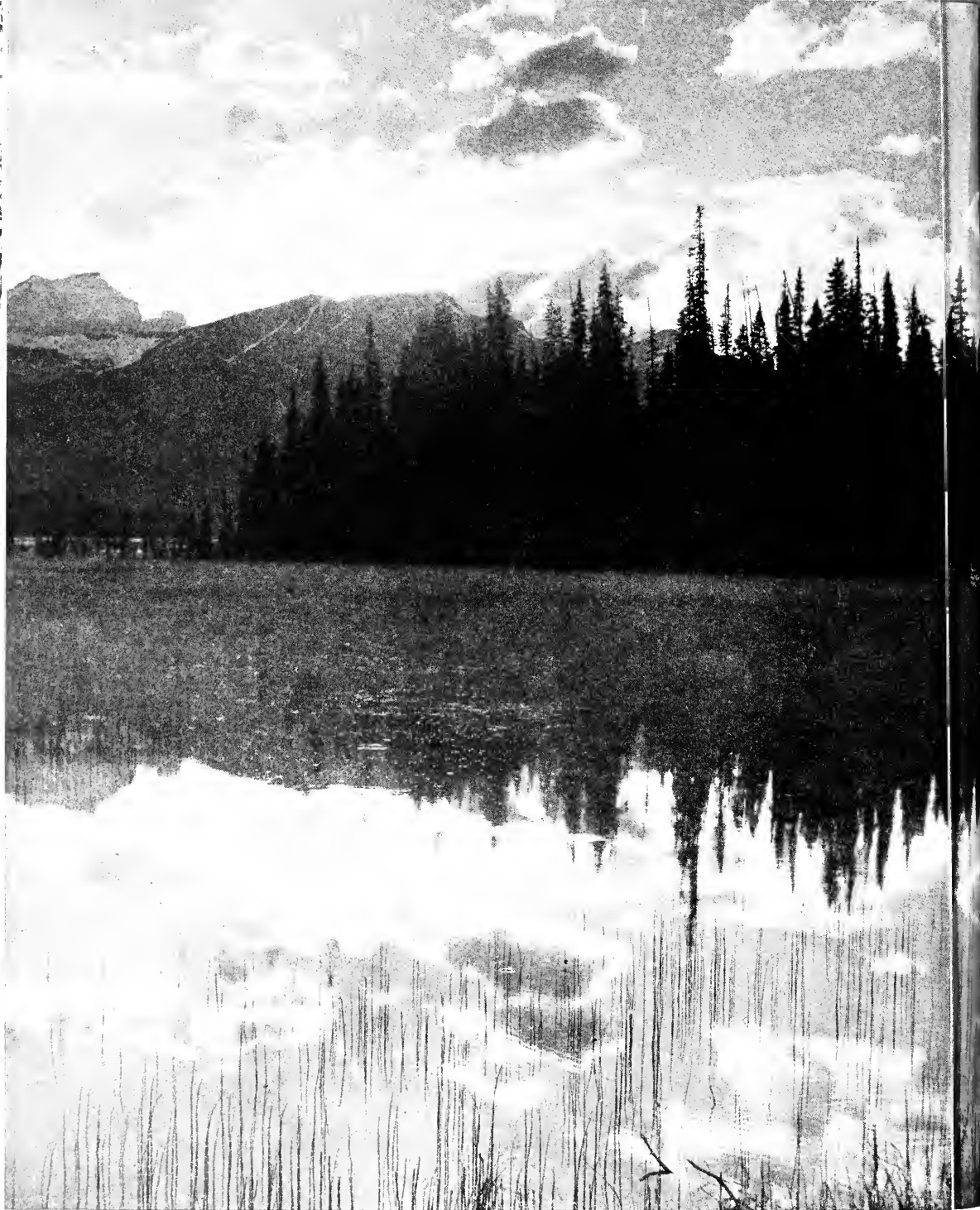
Each of these jugs is a little nest stocked with caterpillars. It is produced with a little liplike margin running around an opening near the top. Through this opening, the female wasp inserts small caterpillars she has paralyzed with her

sting. When the jar is well stocked, she attaches a single egg by means of a delicate thread to the top of the interior of the nest and then seals the opening.

Within, the egg hatches into a tiny carnivorous larva. It feeds on the living food that has been stored up for it, grows, transforms into a pupa, and emerges as an adult all within the protection of the masonry walls of its nest. Only when it has reached its winged form does it make its escape. Then it bites its way out through the side of the jug, leaving a gaping hole in the wall, and flies away in search of

nectar and a mate. So narrow-waisted are these adults that the abdomen where it joins the thorax, or mid-body, is hardly thicker than one of the insect's legs.

The work of the female wasp in stocking the nest is of great value to gardeners, fruitgrowers, and farmers. Cankerworms are a favorite prey of *Eumenes fraternus*. These and immense numbers of other agricultural pests are destroyed each year by the activity of these insect potters.



▲ THE BEGINNING of a twilight that lasts all night: sunset on the Rockies north of Banff, Alberta, where there is no true night in late June and early July. The

sun sets late and rises early, and it is never far enough below the horizon for the land to become really dark. There are fewer nocturnal animals in the north

# The Twilight Shift

Even in a rocking chair on a well-screened porch you can discover a new world of nature, in which special organs of sight, hearing, and scent are attuned to the peculiar conditions of dawn and dusk

By LORUS J. and MARGERY J. MILNE

*Photographs by the authors*

MAN is a prisoner of daylight. Since prehistoric times he has striven to burst the bars by building campfires, lighting candles, or inventing other sources of artificial illumination. But all of these are poor substitutes for the sun, and beyond their glow his footsteps falter. The unknown reaches out to grip his mind in nameless fears. "Is not the midnight like Central Africa to most of us?" asked Thoreau. Few of us, in fact, ever attempt to explore the night. Yet the hours of darkness offer fascinating discoveries, and if a person trains himself to make the best use of his eyes, this strange world is his for the asking.

Outdoor observations usually brake to a reluctant halt at dusk. Often the most interesting facts seem just about to come to hand when the light fails. Indeed, one of

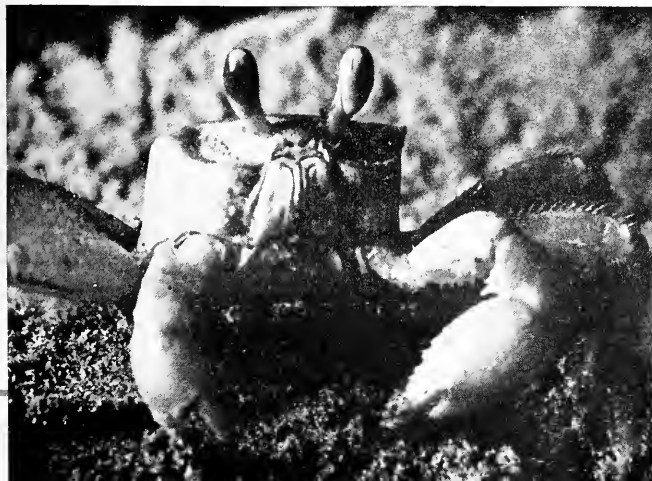
the best reasons for moving to the north woods for the summer is that the days are longer there. Birds that know no union hours in feeding broods of hungry young are believed by many to make their spring migrations chiefly to take advantage of the more extended light in northern regions.

The length of a day is an extremely variable quantity. If twilight be added to the actual time the sun is above the horizon, the variation is even greater for most inhabited parts of the earth. Season and latitude complicate matters. Thus Charleston, South Carolina, has 54 minutes more of sunlight on New Year's Day than does Boston, Massachusetts. But twilight almost equalizes things by being about 30 minutes longer at that time of year in the northern city. At summer solstice, Boston's day is a whole

hour longer than Charleston's, and twilight adds a 70-minute extra bonus. Night is crowded into less than four and a quarter hours. Yet these cities are but ten degrees of latitude apart (about 700 miles measured north and south).

At the latitude of Boston, street lamps are scarcely needed until nine o'clock standard time in summer, and twilight lasts until seven minutes to ten. Along the north shore of the Gulf of St. Lawrence,

▼ A GHOST CRAB, active on the beach at night, raises alert eyes on upright stalks to survey the surrounding scene. If danger threatens, these eyes may be dropped into protecting grooves on the hard body. Hundreds of these crabs feed side by side at night in the wet sand of a beach that seems entirely deserted through the day



▲ THE SMOOTH SAND of the beach records the activities of animals both night and day. Here the prints of eight sharp-tipped running legs of a nocturnal ghost crab (left) cross the hurrying toe marks of a coastal bird of the sparrow kind. Both creatures share the same beach but seldom see each other



▲ A TWILIGHT SCENE caught by photoflash through four feet of water: King Crabs in Delaware Bay. The smaller male has hooked its claws to the female's shell and is forcing her to drag him with her until she lays her eggs in a hollow scooped in the sand. Sometimes several males are towed

approaching the Labrador boundary, and throughout much of western settled Canada, twilight extends from sunset to sunrise. There is no real night at all in late June and early July. These features impress the traveler, but they have even more pronounced effects on the kinds of creatures that live in various parts of the world. In the Arctic, summer is the warm, sunny season, when animals depending upon daylight vision can be up and about. Night is absent altogether there for much of the year. Naturally, nocturnal creatures would have difficulties, and there are fewer and fewer of them the farther north one goes. At the same time, animals living in the far north need good vision for twilight or night unless they can hibernate.

Man's vision, to be sure, is provided with enough adaptability to allow him considerable activity during twilight or even under the open stars. Yet so linked to daylight is his mind that until a few years ago

he had never bothered to measure the brightness of the night sky. Scientists finally accomplished this in the early 1940's. Avoiding the Milky Way and the moon, they were surprised to find that the sky was a dark gray, not a black. Between the stars was a night illumination that proved to be almost a universal constant, with the same value all over the earth. Then, with the obvious fact stated in photometric units, the experts recalled having awakened under a moonless, starlit sky to discover that they could see a great deal in this dim, colorless light. After several hours in the dark, their eyes could recognize the silhouettes of trees against the sky and even distinguish the features of distant landscape.

Few animals have better eyes than man when night operations are necessary. Ours are large in comparison with most, and our pupils open wide like the iris diaphragms on expensive camera lenses. In the semidark, the light-recording retina becomes increasingly sensitive as the minutes pass. And by making use of cues offered by the whole field of view, we can extend our vision into realms of the night where we suppose cats and owls alone can see. Actually most of the many creatures that are abroad when twilight's glow has gone depend less on eyes and more on scent and sound to tell them what they need to know. When the warmth of the sun is absent and there is no wind, the night air hangs quietly close to the ground. Lack of upward currents enables sound to travel for greater horizontal distances, and odors diffuse farther, too. Ears depend more on their own keen abilities when eyes are unable to be of much help. The lack of competition between the rival senses makes the mind more alert in judging noises in the night.

One of the pleasures of camping in the wilderness is in wakefully following the transitions of twilight. Even in the tropics, night does not end with the suddenness that has been credited to it. Only Kipling could make the dawn come "up like thunder outer China 'cross the Bay!" Nor does night descend again

like a black blanket thrown over the earth. There is time for the eyes to become accustomed to the dark. Pupils open wide in less than a quarter of an hour, and the retina approaches its maximum sensitivity in three times this long.

Darkness appears first in the woods, spreading through the thickets and into the valleys. Day lasts longest in the open pasture and on the mountain crest. Distant hills clip off the setting sun at a pace as perceptible as the movement of a clock's minute hand. White sunbeams, shorn of their blue by dust and moisture in their long slanting path through the earth's atmosphere, spread a reddish glow on western hillsides. Finally, the sky reflects only a baleful greenish light, or clouds high above return a rosy brilliance to the land below. Throughout the twilight, countless creatures recognize their signal. It tells some to find places of concealment for the night. Others it advises that they may now come forth in relative safety. Most of their daytime enemies are inactive and becoming blind.

We can think back to many sounds that are typically part of the night—the spine-tingling yowl of a lynx in the Canadian wilds, the snorts of pack horses browsing near our tent, the unfamiliar identification call of "Chuck-Will's Widow" in an Ozark wood lot, the trilling of toads along a man-made stream in a Philadelphia park. Amidst a boundless orchestra of tree crickets, we have sat enchanted while a single fiddler continued his call for a deaf mate in spite of the beam of our flash lamp. Even the click of a cheese-baited trap is a night sound. The instrument of death lies waiting but untouched all day and into twilight. Yet when night has fallen and the mice come out, the passive thing springs into action.

Other sounds are as obviously part of day. The house wren, resting a moment on the doorway of its nest, plays through the same nervous chattering song, over and over. It rings out again from the bushes where the bird is seeking more and bigger monthfuls of long-legged crane flies. Soon it will be back to

its young, its head almost hidden by the brush of insect appendages. Even this handicap cannot break the sequence of the song. The whistling wings of mourning doves, the whirr of a startled pheasant or grouse, the cheerful chirps of chickadees and juncos, and the melody of the song sparrow are all related to full daylight, when these seed and insect eaters can find their tiny food by sight.

But some sounds are just as characteristic of the twilight time. They follow through a regular repertoire at the break and close of day. As the dim light of approaching dawn begins to spread across the sky, and human eyes fail to distinguish against the brightening background stars of progressively greater magnitude, the owl's hoot and the muskrat's splash vanish with the noises

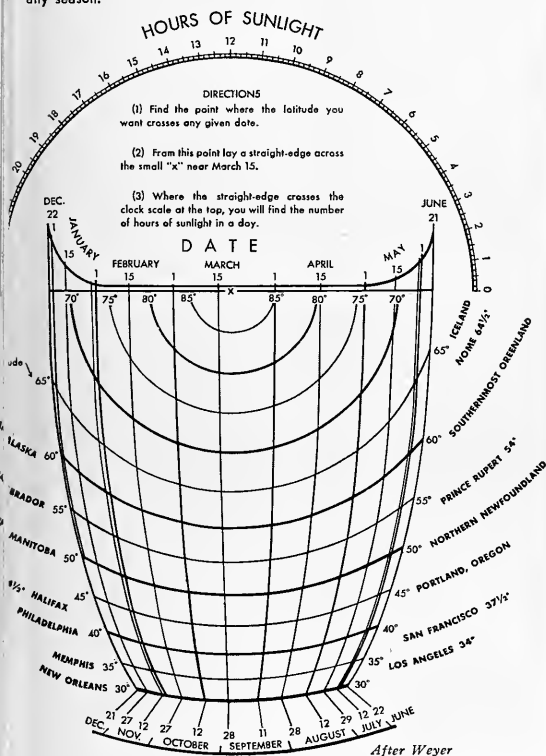
of the night. A robin tries a lonely solo. The first notes are hesitant, as though the bird had almost forgotten the tune or was concerned for fear the pitch was wrong. Speckle-chested thrushes begin their arpeggios of harmony. Most of these birds are wide-awake but have not yet left their perches since night still lingers among the undergrowth in which their food is hiding. Soon warblers join the growing chorus and flit about to investigate the brighter side of tree trunks and exposed leaf surfaces for bugs and sleepy flies. The robin is no longer a soloist; many of his brethren add their full-throated contributions to the spreading volume of sound. This twilight time initiates the vigorous "Cheer" call of the cardinal, the endless imitations of the catbird and brown thrasher. But as the sun

appears over the horizon, the noises die away like conversation at a dinner table when the main course is served. The birds are far too busy eating, breaking the night-long fast and gathering food for young.

At dusk the cycle of events repeats itself, but in the opposite direction. Nor are sounds the only clues to activities of animals near by. In complete silence through the gathering shadows, deer lead their freckled fawns from leafy shelters to feeding areas under the open sky. We recall many evenings when a few of these graceful creatures slipped by within a few feet of us. Others must have waited for complete darkness, for the well-worn path showed great numbers of fresh hoof prints each morning. Another memory is linked to a lonely forest campsite in New Mexico. We were

#### HOW LONG IS A DAY at any place, at any time of year?

Everyone knows that the days get longer in summer and shorter in winter. But the actual length depends upon your latitude. Here is a rapid method for finding the time between sunrise and sunset in any latitude from 30 degrees N. to the Pole at any season.

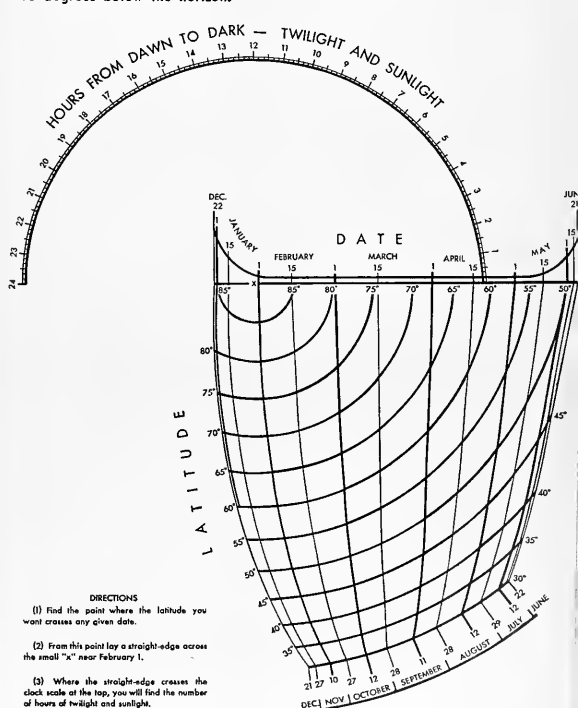


#### HOW MUCH TWILIGHT IS THERE?

It begins to get light before the sun actually rises, and real darkness does not come immediately after sunset. This chart gives you the number of hours between earliest morning twilight and real darkness after sundown. It will show you how much longer twilight lasts in high latitudes than in low.

If you want to find the duration of twilight in the morning or evening, subtract the length of sunlight, as found on the other chart, from the length of time indicated by this one and divide by two, for twilight is the same morning and evening.

Astronomical twilight, shown here, lasts as long as the sun is no more than 18 degrees below the horizon.





preparing late supper by flashlight when a low dark shape approached from the clearing. Its solid silhouette and lumbering gait told us that it was a bear, long before we shone the light in its direction. It, too, passed within a few feet, clinging by habit to a trail that led to the river. The only concession to our presence was an occasional turning of its head to watch us. Each time it looked our way, the beam of our flashlight was reflected back to us as a pair of reddish eyeshines, set close together like the beady eyes of a toyland effigy. But the silent bear was far more interested than it cared to show. Each morning the earth around our tent gave evidence that the big animal had circled the canvas repeatedly during the night, without even an audible sniff to disturb our sleep.

The transition toward night actually begins before the sun goes down. Rabbits become active and tree frogs commence to voice their penetrating, whistle-like calls. Cardinals may cease activity as much as ten minutes before sunset, and crows settle for the night with the last rays of the sun. The next 20 minutes end the day for most of the seed- and insect-eating birds, though robins and mockingbirds may continue to sing for as much as half an hour into twilight. Mosquitoes and fireflies appear in numbers about fifteen minutes after sunset, a little before the whip-



▲ CAMOUFLAGED against the bark of a tree all day, this moth waits for twilight with large eyes and odor-sensitive feelers ready to search out night-flowering shrubs that offer nectar. These insects pollinate many kinds of blossoms that are not open during the day when bees and hummingbirds are active

poorwills commence their calling, and bats begin to write crazy patterns in the sky. Nighthawks seldom leave their roosts until daylight has dwindled and their camouflage is no longer needed. Then they climb into the upper air, alternately beating their long wings to gain altitude and coasting downward. Their cries come back to earth at regular intervals that match their undulating flight—one cry, one pause in flapping wings. Many of them patrol

a regular beat in the sky. For a series of evenings we kept tally for half an hour or more, while one bird made a seemingly irregular circuit just fourteen calls in length. The final call coincided with one special landmark visible only to the nighthawk. At this same spot each time, it took a wing-closed dive, plummeting earthward hundreds of feet. Although we could see it no longer through the trees, the dull metallic ringing sound told us when the bird braked its descent with spread pinions.

The number of animals abroad at night is often beyond the imagination of the uninitiated. Only a rookery of nesting sea birds or a living wave of fiddler crabs on a tropical beach give the same impression by day as the abundance and proximity of nocturnal creatures feeding side by side. Ghost crabs along the limit of farthest wave-advance, dipping sensitive nippers into the sand for minute bits of food, are unbelievably numerous at midnight on a shore line that seems devoid of life all day. W. H. Hudson tells of entertaining visitors from town through a demonstration of the number of near-by animals. After supper he would take them a little

▼ CAVERNS offer solace from the sunlight for creatures of the twilight. In the narrow mouth of this Pennsylvania cave, many crepuscular and nocturnal creatures take refuge for the day. It offers eternal darkness only a short flight from open air, from days and nights and seasons





distance back of the house and allow them to stand still a few minutes to "feel the silence" of the pampas. Then he would fire a gun to frighten the rat-sized viscachas feeding in the grass. In a few seconds his guests would hear "an extraordinary hullabaloo, a wild outcry of hundreds and thousands of voices from all over the plain for miles around, voices that seemed to come from hundreds of different species of animals so varied they were, from the deepest booming sound to the high shrieks and squeals of shrill-voiced birds." Yet this uproar came from a single kind of creature that had waited until night so that it might feed in peace.

There is all the thrill of living a detective story when one sits quietly in the dim light of dusk or dawn and tries to identify the various animals that move near at hand.

Little fluttering wraiths give off a soft muttering whirr as they hover and dart around a flowering shrub. In daylight they are sleepy moths, but in the darkness they take the place of swift-winged hummingbirds. They tend the flowers and accomplish pollination for many kinds that are not open while bees and birds are active. The sound of moth wings is very different from that of the "shard-borne beetle with his drowsy hum." The chafers have a rough harshness in their buzzing, and they blunder into foliage or tumble clownlike to the ground when they attempt to settle on a plant.

Fireflies rest on leaves or blades of grass and practice pulsing their abdominal lamps. Others take to wing and show off the full brilliance of their greenish lights. Through the dusk each can be seen to pause

in its slow forward flight, at almost regular intervals. Then from the vegetation it zooms upward like a helicopter, blazing with luciferin, only to extinguish the cold fire, descend, and move on. The males, with far larger eyes than their mates, are the chief light producers, the main actors in this nightly ballet. But they are not the only luminescent beetles that make an appearance in the twilight. One evening near the McDonald Observatory in the Davis Mountains of southwest Texas, we met an unfamiliar member of another insect family. From the chilly July air we had taken refuge in the car, with windows closed and dome light shining down on maps and notes. Suddenly two lights appeared, close together on the windshield in front of us. The side window showed two more pairs, and the back window had a pair, too. These lights were all around us, always in pairs about the same distance apart. One of us got out to investigate and returned with click beetles in both hands. Like eastern click beetles or Jacksnappers, these tried hard to jerk themselves from our grasp, but all the while their two little points of luminescent greenish-yellow glowed, somewhere amidships on their bodies, both above and below. As we sat there, more were attracted by the car's cabin light. We shut it off for a few minutes. In the dark, dozens of the creatures were flitting around, like fireflies and yet not fireflies, each with its tiny pair of bright beacons.

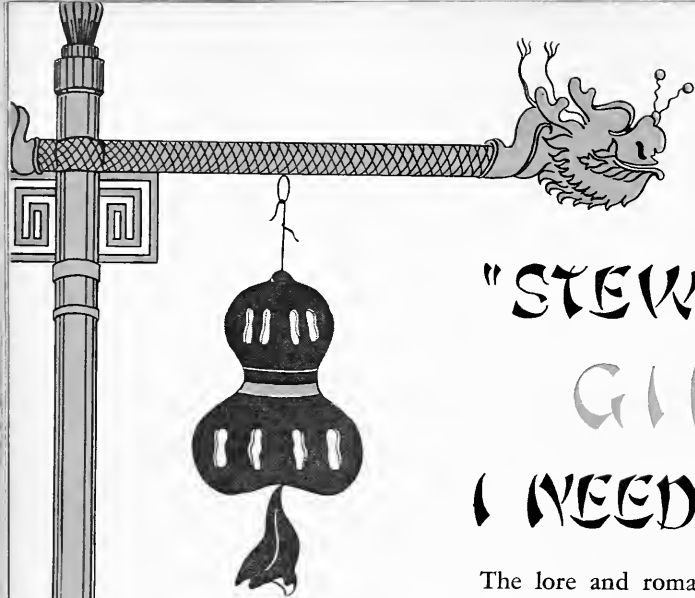
*Continued on page 430*



▲ WITH EIGHT EYES, this spider explores the woods at night and through the twilight times. These eyes, which are large for spiders, enable the creature to see in front, to the side, and to the rear. Prominent highlights show the position of the largest pair. A row of four others are in front, another pair, behind. Its enemies include owls, whippoorwills, and other animals of the evening

➤ THROUGH THE NIGHT, without benefit of enough light to see by, an orb-weaving spider stretched the radial strands of this web and then made a growing spiral of sticky silk. An outstretched foot (one of the eight) kept the spacing between circuits of the spiral. This web, sparkling with minute dewdrops, has had at least one day's use, as indicated by the many holes





# "STEW ME SOME GINSENG. I NEED STRENGTH."

The lore and romance of one of the world's strangest million-dollar industries—from the picturesque Manchurian ginseng hunter, with his birchbark hat and panther skin, to his American counterpart in our eastern woodlands

By JENNIE E. HARRIS

FOR centuries, all Chinese people have believed in the power of a little root. "Jin-tsan," they call it. It is at times about the size of a small parsnip, two to four inches long, with wrinkles running around it. Maybe 16 dried wild pieces will weigh a pound; or perhaps it will take several hundred pieces to weigh a pound—with sales as high as \$400 an ounce. We export to China about a million dollars' worth of ginseng a year.

A sign enameled green, gold, red, and blue may greet your eye on a Chinese street: "Here are sold deer's horn pills and ginseng." Other signs on this narrow cobblestone street bear similar messages, for this is ginseng street. Within odorous distance may be sandalwood street, where shops offer sandalwood fans and sandalwood incense sticks to burn in temples. Not far away may stretch coffin street, where sons and grandsons come to select fine wooden coffins to present to fathers and grandfathers on their sixty-first birthday, for elderly Chinese like to feel ready for death.

But ginseng postpones death. Deer's horn pills may cure epilepsy, but ginseng, in strengthening and building Chinese flesh and bone and spirit, prolongs life.

You enter a doorless opening.

Here no ginseng or any other item is on display as in an American drugstore. The merchant in his black gown and cloth shoes, his eyes like little black buttons in his ivory face under the black skullcap, counts up your purchase on an abacus of wooden balls and wire. But the ginseng he weighs out for you looks like the ginseng you might buy in an American drugstore, if you happened to find it. You won't come across it easily, though, for we ship about 99 per cent of all our ginseng to China.

If American ginseng is in this shop of the deer's horn pills, it must have taken on magic somewhere in its shipping. American doctors assign only mildest healing powers, if any, to ginseng, including the Asiatic kinds. Chinese doctors, the most eminent among them, have added volumes to a literature that was already enormous when King Solomon wrote his Songs—books extolling the virtues of this wrinkled little root.

"Oh, well," you might comment, "the Chinese have queer superstitions about medicine anyway. Con-

sider their belief in tiger's whiskers—some of their most expensive pills are of tiger's whiskers, weighed out like so many pellets of gold. They believe that eating dog's flesh gives courage. They use asbestos, moths, snake skins, and oyster shells in their medicines. Elk hoof cures hysteria. Powdered rhinoceros horns are for all sorts of malignant fevers. Doesn't the crest of their Society of Apothecaries have a rhinoceros on it? They give powdered turkey's tongue to consumptives. To be sure, they like pleasing ingredients—almonds, orange bark, gentians, chrysanthemums . . ."

## Foods as Medicines

One thing to remember is that the Chinese make little distinction between medicines and foods. They eat to steer clear of disease. Their medicines become stews or soups, well mixed for flavor and texture. "Stew me some ginseng. I need strength," and from the ginseng root in the cupboard drawer, a little piece is cut and boiled. A tea-cupful is drunk as an energy tonic for the living as well as for the dying.

The Chinese seem always to have liked and used ginseng. Their earliest writings mention it. Some long-ago forester, perhaps, while digging up roots for something to eat, unearthed the first ginseng to be found. If this was a kind now most revered, he must have gazed at it in wonder. For here, alive and growing, was a little human figure, a wrinkled doll with arms and thighs, the limbs not folded as a mummy's, but in the twists of activity. A growing man-image, no bigger than his finger—and he had just dug it up! So he wrapped it tenderly in a leaf, brought it home, looked at it, and began to believe in it.

### "Likeness of Man"

The Chinese word for ginseng means "likeness of man." The herb's taproot, apt to be forked, means—so the Chinese believe—that the root was created in man's image so that man would recognize it as being able to cure his ills. Vigor stored in the root—vigor revealed in the sturdy arms and legs—can be imparted to him who swallows a little of the root. Roots most nearly like

human bodies—fat little roots with well-developed arms and thighs—possess magical powers. A Chinese feels better just in owning such a root.

Then the leg and thigh parts can cure leg and thigh troubles. For instance, legs grown from a root as though the root had been running, can heal a child's lameness. Ginseng taken as tea or in little red pills strengthens the lungs and the heart and the liver, brightens eyesight, stops indigestion, and helps make one immune to disease. Formulas for the small red pills are kept secret in families for generations, and their sales are enormous. The pills weighed on scales are balanced against a bar of silver.

Chewing ginseng imparts endurance. Loubère in 1688 wrote, "He that hath this root in his mouth will hold out at labor as long again as he that hath it not."

Several Chinese doctors who have studied in America are back in China studying ginseng, unable to understand how we value it so lightly, whereas to them it has the highest, most enduring building power of any tonic known. They say its action, slow and gentle in itself, has almost magical effect. Chinese public speakers take ginseng before and after their speaking tours, because it more than soothes them. Our U. S. Dispensary says ginseng increases blood pressure and rate of respiration but is good only as a demulcent. The Chinese believe it is too heating for Americans, who are temperamentally too hot anyway.

A cup of ginseng tea given to a Chinese on his deathbed is believed to hold off death five days, enabling him to attend to his affairs and making it possible to move him to a wooden board on the floor on which to die, thus preventing his spirit from inhabiting his bed forever.

In 1714, Father Jartoux, a missionary in China, published in *The Philosophical Transactions of the Royal Society of London*, a description of "A Tartarian Plant called Gin-seng." This article with drawings came to the attention of Father Lafitau, a missionary among the

Iroquois in Quebec, and started him searching for ginseng in the Canadian wilds. In two years he found it growing in Montreal. It was not exactly the Chinese ginseng but an herb so similar that almost at once Canadians began selling the roots to the French at 35¢ a pound. Then the French sold them to China at \$3.50 or more a pound.

*Panax quinquefolium*, botanists call American ginseng, allying it to spikenard and wild sarsaparilla. *Panax schinseng*, *panax* for panacea, is the Asiatic kind. But Chinese druggists admit that the difference between the roots is largely imaginary, though they sell Chinese ginseng at a higher price when they know it to be Chinese.

The price for Canadian ginseng rose to \$5.00 a pound. Canadians and Indians rushed the roots to market, but they dug up immature roots, dug them in summer before seeds had set and before nutriment had been stored in them, or they dug the roots up carelessly, injuring some of the appendages. And the Chinese, with their love for jade animals, silken gowns, screens inlaid with tourmaline and mother-of-pearl, required quality also in ginseng and rejected these inferior roots. Trade dropped from \$100,000 a year to \$6500 and soon ceased completely.

### An early American Industry

Meanwhile, New Englanders and settlers in almost every state east of the Mississippi and a few states beyond, were finding ginseng in its favorite haunts of oak and maple and beech forests, flourishing in that wealth of leafmold among few other undergrowths. It was easy to spot because of its arrangement of five leaflets—three about four inches long, two an inch or so long—all five splayed out like the fingers of a hand; because of its erect flower stalk, a half-foot or more tall from where the leaf stalks branch; because of its umbel of yellowish-green flowers, a little like carrot-lace flowers; and because of its scarlet berries in the fall, their brightness seeming to shout "Ginseng!" even at a distance.



Photo from New York Botanical Garden

Ginseng's erect stalk, five leaves, and scarlet berries make it easy to spot

"STEW ME SOME GINSENG. I NEED STRENGTH."

Settlers could kneel down close to the herb, scrape away dead leaves, and count the scars at the neck of the root, one scar for each year of growth. Then when they dug up a six-year-old or a seven-year-old root and shook it free of soil, there was the thick, soft pale "parsnip" with its rings of wrinkles and its frequent arms and thigs.

"Garantoguen," the Iroquois called ginseng—"man's thighs and legs separated." They devised a way to cure the roots to a dry, ivory-clear translucence.

#### Daniel Boone Gathered It

"Sang," Americans called it. "Go look for sang." There was a minor gold rush for it, the berries summoning from afar like flags. George Washington wrote in his diary after a visit to Ohio in 1784, "In passing over the Mountains, I met numbers of Persons and Pack horses going in with Ginseng." Daniel Boone in 1788 gathered sang in Kentucky and took the roots up the Ohio River to ship to Philadelphia.

Roots were about 34¢ a pound in those days; then came a gradual climb in price until in 1858 we exported 350,000 pounds to China, at 52¢ a pound. By 1891, we had reached an average of 500,000 pounds a year to China. By 1897, the recorded price was \$4.71 a pound. Forests back of the Catskills extended for 20 miles, and there whole populations turned out for the day, locked their houses, took lunches, and trudged afoot the short distance into the forest to pick ten pounds of green roots a day for New York to export to China.

New York retail stores stocked ginseng along with their camphor and pomades. Missourians found ginseng growing in oak woods and dried the roots. First they used slow ovens, but that proved too hot a method; then they strung up the roots in kitchens to dry, but that made them off-color. Then they devised drying boxes, let the roots dry for a month or six weeks, rubbed off the fine fibers when these became brittle, trimmed the roots, smoothed them gently between their hands till they were bone-dry,

slick, and ivory-yellow. They sold these to local agents or kept them for home use.

As early as 1710, American colonists had heard from travelers or discovered for themselves about ginseng. It became a mildly medicinal chewing gum because of its peculiar licorice scent and aromatic flavor. Children were given doses of one or two teaspoons of powdered root in a little hot water, sweetened, to encourage appetites or strengthen digestion. Fainting daughters drank ginseng steeped in camomile-flower tea. A decoction of a fourth or a half cupful two or three times a day was prescribed for various ailments.

Dr. Gunn's *Family Physician*, a book my mother referred to in tending the ills of six children, gave ginseng its alphabetical place in medical flora, along with numerous herbs, wild plants, and barks.

"The root is a mild tonic nerveine and somewhat stimulant and diuretic, and may be used either in substance, decoction, or tincture—most commonly used as Bitters, along with other articles. Useful in nervous debility, weak digestion, feeble appetite, as a stomachic and restorative. Considered a very valuable medicine for children; has been recommended in asthma, and nervous affections generally."

English shops sold ginseng as "rinsi," one ounce being worth 40 ounces in silver. We are told that the first New England ship to sail for China, the sloop "Harriet," carried ginseng, but the captain traded it to an English captain for tea.

When the price for Manchurian ginseng mounted to \$400 an ounce, frenzied gathering of American roots all but exterminated ginseng in many states. Then people invested in cultivating it. Stanton at Summit Station, New Jersey, in the early 1880's, seems to have been the first successful grower. He transplanted wild ginseng and later grew ginseng from seed, giving it moist leafmold and good drainage, with morning-glory, bean vines, or lathes for shade. This delicate herb thrives only under shade.

Ginseng roots sent to China in 1908 brought over a million dollars—154,000 pounds of them. In 1921, 20 acres, most of it in New York

and Wisconsin, were under cultivation for ginseng. Fair roots sold around \$4.00 a pound, better roots around \$5.00, extra good ones for more than \$6.00. In 1918, China was paying \$9.00 a pound; by 1926, an average of \$19 a pound—and \$200 each for roots that were human-like and of clear color.

#### Ginseng Cultivation

Yet many who tried to grow ginseng failed. They had humus, potash, and phosphorus in the soil but also nitrogen. Ginseng does not like nitrogen. An estimated \$1500 an acre is required to start growing ginseng. It takes the roots five to seven years to mature (some authorities say ten), and some seeds do not germinate until the second year.

Today's horticultural papers offer ginseng seeds at from 1¢ to 5¢ each, one-year-old plants at about 15¢ each, three-year-olds, 25¢ to 40¢ each. Bulletins tell how to grow ginseng in orchards, gardens, and woods. But the curing still takes skill. The Chinese are said to draw silk threads through the tiny wrin-

Photo by Arthur C. Parsons



▲ DIGGING A GINSENG ROOT in Pennsylvania with the traditional homemade "sang hook." Only large, mature plants should be removed

kles to clean them. They wrap the roots in oil paper and then steam them in a sort of double boiler. Then they dry them in an open shed to a pale clear amber. Korean roots are reported to be clarified with honey. An American way is to cure the roots for a month, then place them in hot water, brush them, and steam them. They shrink in drying. A fresh thirteen-ounce root may weigh only two or three ounces dried. The Chinese like short, thick, spongy roots, light in weight, light in color, carefully sorted as to weight, smoothness, age, and color.

For a while, cultivated ginseng brought 20 per cent more in price than the wild. The cultivated roots usually weigh more, shrink less, are whiter, more brittle, clearer, and more translucent.

Now the wild again has preference. In 1937, cultivated roots brought only \$4.00 a pound, against \$15 a pound for the wild.

Again, the one big source is the forests. The New York Department of Agriculture answered a query by stating that scarcely anyone in New York except the herb-fancier now

grows ginseng. I learned from Iowa that Otranto Station, near the Minnesota line, has had a flourishing ginseng arbor. At one time 500 pounds shipped from there brought \$8500, but internal strife in China closed the market.

Trappers in Canada and the United States find ginseng growing near their traps. They dig up the roots and bring them to fur dealers with their pelts. Then the dealers sell the roots to Chinese agents.

#### The Sioux in Oriental Trade

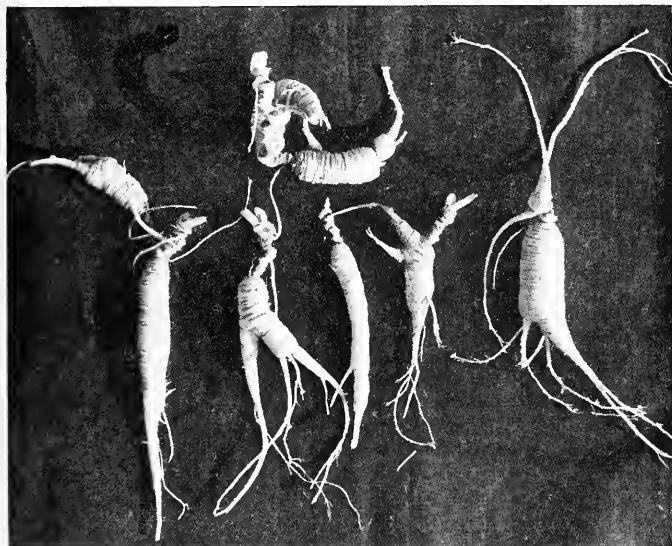
The International Ginseng Co. of New York was formed in 1916 for the sole purpose of exporting American ginseng to the Far East. They ship usually to Hongkong; from there, the roots are re-exported to Shanghai, Tientsin, and other districts. According to them, ginseng must be cured within two days after it is dug. Best are the roots that have been cured by the Sioux Indians, who still use their secret way of making the roots translucent. Many of the roots the International Ginseng Co. ships resemble the human body.

These North American roots, plus roots from North China, Korea, and Manchuria, still cannot total enough ginseng for 400 million people who like to take ginseng constantly as part of their food in order to pro-



▲ MAN-SHAPED ROOT of American ginseng. Its curious shapes have helped establish the belief that ginseng was put on earth to ease a multitude of physical ills

*Photos by Arthur C. Parsons*



▲ GINSENG ROOTS just after being dug up. High prices in the Oriental market have made it worth-while to process the roots according to time-honored methods, making them bone-dry, ivory-yellow, and even translucent

➤ GINSENG grows only in rich soil in shady places, principally in hardwood timber on slopes facing north or west



"STEW ME SOME GINSENG. I NEED STRENGTH."

long their life with its quiet strength. Moreover, aside from medical uses, they stew ginseng in their leisure for pleasure—just as they fly kites, play mah-jongg, drink tea, plant flowers, and enjoy the crisp resistance of bamboo shoots.

Kaijo, center of the Korean industry, grows ginseng under leaf-woven mats, one crop each fourteen years; that is, the Koreans allow seven years for the roots to mature and then let the land lie fallow for another seven years or plant another sort of crop. The court of Korea formerly paid ginseng roots as tribute to Chinese rulers, roots that took 30 years to mature.

In Manchuria, whole families labor in the ginseng arbors, women cleaning the roots, men sitting on floor mats and sorting the roots for packing.

#### The Manchurian Ginseng Hunter

Wild Manchurian ginseng ranks highest of all. Clarified roots sell for their weight in gold. The wild ginseng of Manchuria flowers but once in seven years, and the delicate rose-pink flowers are said to be exquisitely beautiful.

But it is not because of the rare flowers that Manchurian ginseng seekers make their search a sort of cult. Travelers who know these seekers tell us we can always recognize them by their dress, whether in the market place selling their treasure or off on the hunt. They wear a tapering birchbark hat, an oilcloth apron fastened to the belt at the front, a panther skin hanging from the belt at the back, and a leather bag strapped to their shoulders. In their eyes is a happy childlike look, expressing a simple, quiet faith.

Under the Manchus, the only Chinese allowed to enter Manchuria were seekers of ginseng and of falcon feathers. Now Chinese are there by the millions but not in the forests.

Wild animals move in the thick dark forests in such numbers as to make tanneries and leather and fur stores thrive. These animals furnish tiger and mink linings for the brocaded silk robes of merchants. Bandits gather at the fringes of the forest, bandits with curious courtesy

and a strange code. They give their victims a little red-bordered flag to carry, as proof that they have been robbed by one band and should not be forced to pay tribute to another.

Unmindful of tigers and of bandits, the ginseng seeker goes deep into the forest, armed only with a stick and with belief in his mission.

An aged man with a stick for scraping away dead leaves to find ginseng has little defense against tigers. But tigers and snakes were appointed by the Creator to guard ginseng, "the root of life," and will not harm a man pure of heart. Moreover, some tigers are transformed ginsengs. The Spirit of the Mountain watches over true ginseng seekers. Poverty and hunger may have driven the mildest men into this devout profession, but they remain true to it for life.

Perhaps the seeker, with his stick and little bag of provisions, goes toward a forest growth he marked last year by tying up a red rag. Ginseng grew here then but was not of marketable size. This year it will be mature. Yes—his heart ringing like a little temple bell—the rag still shows its red; no other seeker has found it. He prostrates himself thankfully before a small altar he erected of branches and a rock. Then he turns toward the waiting herb.

#### The Treasure

It is late autumn. The leaf stalk has withered. One more scar has added itself to the root's narrow neck. With spade and scissors, he digs and cuts at entangling roots until he can lift the whole root gently. He shakes dirt from its tiny body, its outflung arms and legs, wraps it in silk, and places it in his birchbark box. Then he prostrates himself again before his quiet altar, because this finding of ginseng proves his cleanness of heart.

Then on to the next ginseng, the next, his experienced eye quick to discover where it grows. His pointed hat rattles the leaves he stoops under. Its bark and the panther skin blend with the forest growth. Unless he is killed by a

tiger or robbed to the point of starvation, he repeats his search year after year. All but tigers and bandits respect him, because he brings forth these fabulous wares.

Some Chinese think the roots cry out in pain when torn from the ground. Few dare tear them forth; instead, they usually handle them as gently as if they were babies. Another belief is that the roots move underground, if they wish, to escape being uprooted.

#### The Market

Lucky Chinese, who sit at inlaid tables within sound of bird song over lotus pools, enjoy ginseng daily in soup. It makes them healthier and happier. Tens of millions of Chinese, less lucky, are too poor to have tasted tea ever in their lives. They wear only blue cotton gowns the year around and need ginseng's vigor to enable them to work another twelve-hour day.

Buyers in medicine shops examine the shape, color, and grain of ginseng roots. They may buy ham or shark's fins at the same place, for ginseng is often alongside foods. But the most expensive roots are apt to be remote from any handling, for each well-forked root is kept in a little wooden box with a glass lid. Looking through the glass, one views the tiny, clear treasure lying on cotton, resembling somewhat a pale-amber headless doll.

Faintly fragrant ginseng leaves and ginseng trimmings, tied up in neat bundles, make tea for fever convalescents after the fever is gone.

In ginseng roots exist bitter principles, volatile oil, resin, sugar, mucilage, and starch. However, according to American doctors, there is little therapeutic power such as the energy-building magic that has endeared ginseng to all China.

A Chinese student at one of our universities points out: "It is perhaps worth-while for the Western medical profession to ascertain ginseng's effect on the Chinese in China rather than on Americans, the reason being that the Chinese seem to be more receptive to ginseng's qualities."



# A Hawaiian Fisherman

A graceful art provides  
the islanders with mullets

By JOHN HENRY COON

FOR many years the striped mullet has been a cherished food of native Hawaiians. Baked in leaves of the *ti* plant, we find them most appetizing.

The early rulers built fish ponds in the shallow water close to the shore. These ponds were walled in with rock, with grated openings through which the water from the sea could run in and out. King Kamehameha is said to have had a pond of 600 acres in which the mullets matured. Runners carried the freshly caught fish across the Island of Oahu to his palace.

Living close to the surface, mullets are caught today by the native fishermen in circular nets, about fifteen feet in diameter, which are cast to fall upon the water open to their full extent, the fish's gills be-



▲ A REMARKABLE action photograph of David Kaipuawa, taken at the moment the net left his dexterous hands

coming enmeshed in the net.

To cast the net perfectly requires as much adroitness as throwing a lasso. This photograph of David Kaipuawa of Punaluu, on the north

side of Oahu, is much the best of the many I took or have seen, because it depicts so well the twist of his wrists and hands and his general technique in casting.

## DOWN TO EARTH

*Continued from page 407*

ing itself by 1960. This estimate is perhaps a little scary. Many authorities would add another ten years to the period of self-sufficiency for the nation.

However, the fact remains that our soil and forest resources are being exhausted at an alarming rate, and we must take steps to save what we have and to replenish the soil riches. A program of intelligent lumbering and forest conservation is needed, together with a definite plan of reforestation. Every effort

should be made to conserve our forest lands and to increase their area. Our national and state parks should be held sacred, and there should be no encroachment by self-interested people who consider only their own purses and ignore the welfare of the nation as a whole.

It is scarcely necessary to mention the need of preserving, if at all possible, several kinds of animals and plants that are in danger of extinction. Some of these are of no commercial value, but they may prove to be symbols of a vanishing American prosperity. At the pres-

ent time, the buffalo is apparently safe on reservations in western United States and Canada, but the trumpeter swan is still in a precarious situation, and the elimination of any of its breeding places might mean its end. The giant redwoods are moderately safe only because those who admire them are constantly safeguarding them. Lumbering in reserved areas should be under strict control, and additional areas of young trees should be set aside so that records of the growth of these relics of primitive forest may be kept.



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and children. The cornfield, the caves beyond, and the dancing patio belonged to this typical Tarahumara family. When they came to greet us, we asked if they had blankets, baskets, or ollas to sell. They said they needed everything for their own use, but when we exhibited our stock of red bandanas and cotton manta, one of the young men said he had a bow and arrow to trade. The bow was short, about four feet long, and made of mulberry wood. The arrows were two-foot lengths of the Common Reed (*Phragmites*), armed with six-inch wooden points. Although deer are often hunted with this primitive weapon, the Tarahumaras seem to prefer running down the animal on foot for a day or two until it drops from exhaustion and can be strangled by the pursuer!

By this time we had been gone seven hours and felt that we should let our host return to his ranch chores. But when he saw us begin to pack up the camera equipment, he asked if we would not like to see the Rain Dance. Of course we would, but we explained that we had already inconvenienced him enough, and to wait until late afternoon for the dance would be too much of an imposition. Instead of replying, he addressed a few words to the Indians and translated their answer as, "They will perform the dance now." While the Indians went to the cave for an olla of water and a wooden rattle, we

loaded film and prepared to photograph a Tarahumara Rain Dance.

The men and women formed two separate groups along one side of the sacred patio. The old man raised his rattle; and with the first dry sound from this ancient instrument, he commenced a high, rhythmical chanting and the dance began. Back and forth across the dancing floor the two groups half-walked, half-danced, the women to one side of the cross and olla, the bare-headed men to the other.

Above them the brilliant azure sky was rimmed with great, white, billowy thunderheads piling one upon the other along the horizon.

For half an hour we watched the dance. The stillness of the summer afternoon was broken only by the dry rattling, the wailing chant, the shuffling footfalls of the Tarahumaras as they danced for rain. Although this was mid-June (the Sierra's rainy season), no rain had fallen on the dust-dry milpas for weeks, and there was real need, almost desperation, in this dancing plea for divine help. And the gods must have been watching and listening; for as we took our last pictures and started back up the canyon, large drops of rain began exploding in the deep dust of the dancing patio. Though we reached the ranch house comparatively dry, as we scurried under the shingle roof, the leaden sky lowered a shining, opaque curtain of cool rain between us and the Tarahumaras.

**THE TWILIGHT SHIFT**

Continued from page 423

Sometimes trees gleam even in the moonlight with similar green phosphorescence because of numberless fireflies clinging to the vegetation. Beebe tells of pulling down a branch of such a tree and counting "twenty-six glowing insects, as close together as the blossoms on a Japanese cherry branch. There were hundreds upon hundreds, all clustered together in candelabrad glory..." Yet for all their conspicuous ways, these luminous insects seldom are eaten by bats or spiders or other carnivorous creatures.

Sometimes toads catch them in such numbers that the unquenched glow shines through the amphibian's belly skin and lights up the earth below. But most animals voluntarily pass them by.

When morning sunlight spreads across the fields and into the many

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shadowed recesses between the trees, we see evidence of other night activities. On spider webs, dew-drops glitter like ropes of unmatched pearls—webs that were measured off, supplied with strong radiating cables, and then filled in with sticky spirals, all without use of eyes or light. Orb weavers, doily spiders, snare makers of many kinds employ the night hours to prepare their thready traps. They are active while most of their enemies are asleep. When birds, reptiles, and wasps awaken for the day, the spiders rest in some inconspicuous spot in contact with the web and emerge only in brief rushes to throw a shroud of sticky silk around some entangled captive that seems vigorous enough to escape if left alone.

Even under the midday sun, many parts of the earth are never brighter than twilight on the plains. Under dense masses of tropical foliage, the jungle floor is dimly lit. Entrances to caves have a twilight zone, shared by crepuscular creatures that seek their food outside when the day is done. And in the ocean under the brightest sun, twilight is only a few dozen feet below the surface. The water absorbs the sunlight, taking away the infra-red and the ultra-violet, then the red, next the orange and the spectrum beyond the blue, lastly the yellow-green. Then all is dark. This zone brightens to twilight each day, only to dim out again as the sun sinks below the horizon. Many kinds of fishes and lesser creatures select definite levels in this vertical transition. Those at the lower levels depend largely on occasional carcasses that drift downward to them from the life above. These abyssal fishes and squids have eyes and light-producing spots and streaks along their sides that often make them far brighter than fireflies. Some of the deep-sea shrimps can even liberate

a luminous substance into the water around them, creating a pool of brilliant light that may attract and at the same time dazzle their enemies. This seems to be the abyssal counterpart of the submarine smoke screens that the squid and octopus employ to hide their escape in the daylight levels of the sea above.

Those who wish to use their eyes and ears to follow the change from day to night or night to day, can do so without moving from a rocking chair on a well-screened porch. They can keep their notes while stretched at length in the shelter of a tent. Or they can dose themselves with mosquito repellents, arm their eyes with flashlights, and seek a quiet vantage point in the pitch

dark of the forest. Each method has its advantages. Each will uncover a local and seasonal pattern of life—a memorandum of the sequence in which the birds and bugs and beasts meet their particular portion of the twenty-four hour day. Few of us can forego the insistent urge of curiosity that demands to know more of lives of which we usually see such a momentary part. And the more we observe, the more we can appreciate this new information on the transitions in twilight. It extends the sum of human knowledge in a new direction. Rapidly it adds to our personal pleasure and allows us a better understanding of the many creatures with which we share the earth.

BABY hog  
+  
RUSA deer



BABIRUSA—"hog deer"

## Ask Webster!

BY MABEL IRENE HUGGINS

**T**he advertisement-reading public is familiar with "A is for Aardvark; C is for Cat." In between, we might have inserted "B is for Babirusa." But what do we really mean when we say "aardvark" and "babirusa"? Simply, "earth pig" and "hog deer." You will soon see that there is method in the madness of words.

In the following lists, can you match the numbered words with their literal meanings? A score of 17-20 is excellent; 14-16 is good; 10-13 is fair. Below 10, well, we won't go into that.

### A

1. octopus ( ) "hog fish"
2. porpoise ( ) "great pike"
3. halibut ( ) "raven of the sea"
4. muskellunge ( ) "eight-footed"
5. cormorant ( ) "holy flounder"

### B

6. petrel ( ) "serpent of the hood"
7. quetzal ( ) "lamb vulture"
8. lammergeier ( ) "little Peter"
9. cobra de capello ( ) "dwarf lion"
10. chameleon ( ) "tail feather bird"

### C

11. crocodile ( ) "spotted"
12. gopher ( ) "gravel worm"
13. porcupine ( ) "badger dog"
14. dachshund ( ) "honeycomb"
15. cheetah ( ) "thorn swine"

### D

16. klipspringer ( ) "roller"
17. pangolin ( ) "nose-horn"
18. hippopotamus ( ) "cliff jumper"
19. rhinoceros ( ) "wild man"
20. orangutan ( ) "river horse"

Turn to page 432 for the correct answers

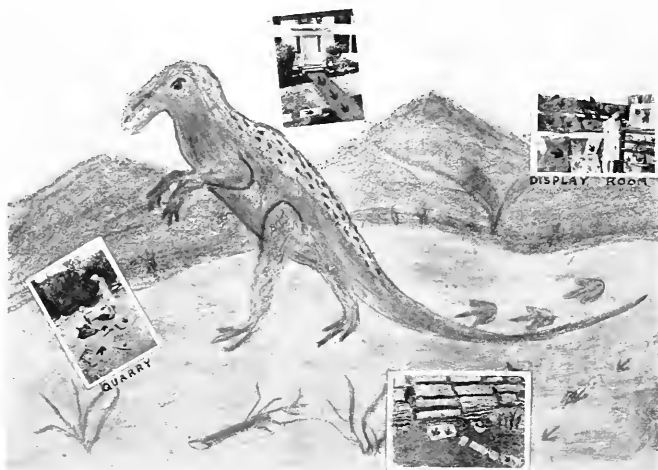
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## CONSERVATION *Continued from 386*

Despite many articles and much talk about its beauty and the need for saving a good example of this forest type, no definite steps have yet been taken to save this unit.

Seen in its proper perspective, this is only part of a much greater problem: namely, that of securing the preservation of at least one good sample of each of our native American plant communities in their original, undisturbed state. These are the only laboratories in which scientists can work out the answers to the many questions that keep coming up in connection with the management of land originally occupied by a given type. For such purposes their preservation is so essential as to make their setting aside justifiable regardless of what it may cost in dollars and cents to do so.

To date, our elected representatives have not seen fit to direct our government to undertake such a project, so it continues to be up to farsighted citizens to carry the burden. If you are one of these and are interested in helping with the acquisition of the Beaver Creek Sugar Pine stand, as distinct from the South Calaveras Sequoia Grove, I should enjoy hearing from you.

**RICHARD H. POUCH, Curator,  
Conservation and  
Use of Natural Resources.**

American Museum of Natural History,  
New York, N. Y.

## BOOKS

*Continued from page 391*

her accounts sufficient material on the habits, conservation, and present status of each species to make them excellent general biographies. Fortunately, the Cruickshanks do not belong to the "identify and run" school of naturalists. The accounts are full of detailed notes on the daily activities of the birds under observation.

All in all, a book well designed to make any naturalist who cannot get away for a spring vacation in Florida chafe at the bit.

**RICHARD H. POUCH.**

## IT TOOK COURAGE

----- by Stanley Rogers

Holiday House, \$3.00  
268 pp., 6 illu.

**C**OURAGE has been defined as that quality of mind that enables one to encounter danger and difficulties without fear, or with firmness. Stanley Rogers has gathered together a dozen or more true tales of adventurous discovery. These stories are not embellished with the imagination of the author. There are no theatrics involved in their narration. These well-selected tales stand on their own merits when it comes to drama and excitement.

Fear is a common enough emotion, and the hardy souls whose exploits are told in this book probably felt fear on numerous occasions, but it is also evident that these people were resolute and undaunted. Most of these tales involve mysteries which were solved—sometimes many years later by explorers as courageous as the ones whose mysterious disappearances prompted the search.

Are there not two tales of courage involved in the finding of the Scottish physician Livingstone by the journalist Stanley? If Sir Franklin who sailed into the Arctic and then disappeared in his quest for a northwest passage was courageous, so were the many explorers who searched for years to unravel the mystery of Franklin's disappearance.

To read this exciting book is to ascend with Salomon Andr  e and his intrepid companion in a frail balloon to attempt to fly over the North Pole; to go down hundreds of feet below the ocean's surface with the brave divers of the "Artiglio II" to recover the "Egypt's" gold. In the warmth and safety of your home you can dig for ancient Viking ships, uncover the Tomb of Tutankhamen, find the lost city of Troy with Heinrich Schliemann, bring to light the dinosaur eggs with Andrews and Granger, and even follow with adventurous scientists on the elusive trails of radar and penicillin.

Those who performed these deeds would probably have denied that they were courageous, but in the author's own words we find an attempt to discover the motivation of the explorer. "It is the uncertain thrill of discovery that lures the explorer on—the precious clues to forgotten history, the mysterious past. He is a treasure hunter without sordid aims."

**JOHN R. SAUNDERS.**

## Answers to Quiz on page 431

### A

1. octopus, "eight-footed"
2. porpoise, "hog fish"
3. halibut, "holy flounder"
4. muskellunge, "great pike"
5. cormorant, "raven of the sea"

### B

6. petrel, "little Peter"
7. quetzal, "tail feather bird"
8. lammergeier, "lamb vulture"
9. cobra de capello, "serpent of the hood"
10. chameleon, "dwarf lion"

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11. crocodile, "gravel worm"
12. gopher, "honeycomb"
13. porcupine, "thorn swine"
14. dachshund, "badger dog"
15. cheetah, "spotted"

### D

16. klipspringer, "cliff jumper"
17. pangolin, "roller"
18. hippopotamus, "river horse"
19. rhinoceros, "nose-horn"
20. orangutan, "wild man"



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# LETTERS

## Gila Monster

SIRS:

My friend insists that the poisonous Gila monster, because it eats so little and is so sluggish, has done away with the need of an opening at the lower end of its digestive tract. He says that the creature lives its life without suffering from auto-intoxication even though it lacks the conventional disposal system. I say that no vertebrate animal has eliminated the need of "elimination." Which of us is right?

L. SPRAGUE DE CAMP.

Lansdowne, Pa.

The following answer is given by C. M. Bogert of the American Museum's Department of Reptiles and Amphibians:

Mr. de Camp is, of course, quite correct in believing that the Gila monster has an opening at the lower end of its digestive tract and uses it. The origin of the notion that the animal lacks this is obscure, but the yarn is widespread in the Southwest. In the days when I worked for the Park Service at Grand Canyon, I rarely failed to have some lad in the audience ask me about this after a lecture. And when I talked at the West Point summer camp during the war, the identical question arose; it seems inevitable.

At Boulder City, the old sheepherder who ran the ferry had circulated the yarn 'here, and when I stated that it was not true, I am sure that I lost face, particularly when I never succeeded in getting hold of a Gila monster to demonstrate the obvious fallacy of the story. I'm sure that the people there thought my knowledge was pure "book learning," whereas the sheepherder supposedly had the real firsthand acquaintance with the beast. If he did, he certainly wasn't very observing.

## Poisonous Leaves

SIRS:

The article in the September *NATURAL HISTORY* on the Koala by Willy Ley is very interesting and enlightening. The findings in connection with the poisoning from certain leaves of the eucalyptus may be somewhat analogous to that of the cherry leaves, more particularly wild cherry leaves, upon cattle. The cherry does not seem to have any ill effects upon stock while the tree is growing, but should the tree be cut or scorched by fire in the pasture, the leaves will have a very poisonous effect upon stock.

I note that koalas in captivity are fed eucalyptus branches, and it might well be that many of the trees had been cut for timber. Perhaps the drying of the leaves causes, as it seems to in cherry, the liberation in larger quantities of hydrocyanic acid. The young leaves of the



cherry seem to contain more of this poison than the old leaves . . .

THOMAS D. WESTFELDT.

Fletcher, N. C.

The following comments are offered by Henry K. Svenson of the American Museum's Department of Forestry and General Botany:

It is sometimes said that one does not remember what he learned in college, but I recall very well being told the facts that Mr. Westfeldt mentions about the wild cherry. It is true that the fresh leaves are not poisonous; the wilted leaves are decidedly so. This is due to the presence of a glucoside which breaks down, due to enzyme action in the wilting condition, to glucose, hydrocyanic acid, and subsidiary products. One-fourth pound of the leaves of young shoots in the closely related chokecherry was determined by the Nevada Agricultural Experiment Station to be fatal to sheep; one and one-half pounds were sufficient to kill a five hundred-pound cow. The reader can find references and more information in the interesting *Range Plant Handbook*, Superintendent of Documents, Washington, D. C., \$2.50.

Other plants, including some grasses, flax, and wild forms of the lima bean, may produce hydrocyanic acid in dangerous quantities. As a matter of fact, it seems

to be a fairly common product, known in at least sixteen plant families and especially characteristic in seeds of the rose family, to which the almond, apple, and peach belong. The native yew (*Taxus canadensis*) is sometimes poisonous to stock, due to the alkaloid "taxin."

## Fiery Serpent

SIRS:

Your interesting article regarding the "Fiery Serpent," and the statement that the Serpent is not known to occur in the United States, emphasizes the limited state of our knowledge regarding the parasitic helminths of this country. Probably your writer is familiar with the confused situation, but for lack of space or other sufficient reasons, he did not care to discuss the problem in detail.

*Dracunculus* occurs in the United States. The internationally known parasitologist, Dr. A. C. Chandler, reported in the

*Continued on page 476*

**NOTICE**—Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on these pages will be paid for at \$3.00 each, with full credit to the photographer. Return postage must be included.

# NATURAL HISTORY

*The Magazine of the American Museum of Natural History*

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VOLUME LVII—No. 10

DECEMBER, 1948

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## THE COVER THIS MONTH

There are many varieties of the Mallow family found in western North America, wild cotton being a member of the group. The more showy ones grow in semiarid conditions over the foothills, drier mountain slopes, and deserts of the Southwest. A great many are perennial, drying back to the root crown each year. Then, as spring comes, with its warmth and rain, a number of flower stems, often three feet in length, shoot up from a single plant, bearing beautiful blossoms at spaced intervals along the stalk. The graceful whiplike stems are never crowded with flowers; each individual blossom is short-lived, and the buds open almost daily in progressive succession and seem to climb up the stem to the terminal bud. This habit gives some of the varieties a long blooming season—oftentimes from early April until midsummer.

The Pink Mallow (*Sidalcea malvaeflora*) shown on the cover was reproduced from a Kodachrome photograph taken by Laurence M. Huey in the Cuyamaca Mountains, San Diego County, California.

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# YOUR NEW BOOKS

BIRDS • HENRY DAVID THOREAU • GEOLOGY  
PRONGHORN ANTELOPE • LAKE MICHIGAN ISLAND LIFE

## MAKING FRIENDS WITH BIRDS

----- by Arthur F. Park

Chatto and Windus, London  
Macmillan, New York, \$6.00  
216 pp., 180 photos

THE author of this book is an English businessman who for many years has photographed birds as a hobby. Disdainful of such artifices as blinds, he prefers, as the title of his book suggests, to make friends with a bird before taking its portrait. The best subjects for such an approach are found among birds busy with nesting duties or among those made fearless by the difficulties of finding a living in the winter. Mr. Park has refined his technique even to the point of giving a nesting bird a preliminary "interview" to determine if it is sedate enough to make further efforts promising.

Each of the familiar British species that the author has photographed is made the subject of a short chapter in the book. The text provides an intimate account of the birds' activities as depicted in the lavish display of fine photographs. Though intended for the amateur, the book contains original observations of value. It was found, for example, that garden slugs enter the nests of willow warblers for some unknown reason. Repelled by these slimy intruders, the birds often abandon their nests. Another valuable study, that of a pair of pied flycatchers, reveals an unexpected difference in the feeding methods of the two birds. Mr. Park delights in manipulating his camera in a treetop or on the ledge of a cliff. As a result, there are fine nesting studies of long-eared owls, European sparrow hawks, rooks, and ravens—species that do not, as a rule, lend themselves to the "friendly approach."

The two concluding chapters on photographic methods contain a wealth of suggestions on handling both equipment and subjects. Complete photographic data are given for every plate in the book. *Making Friends with Birds* will be of interest to every bird photographer. It also provides a charming introduction to English bird-life.

DEAN AMADON.

## SEA AND LAND SHELLS

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## THE PRONGHORN ANTELOPE AND ITS MANAGEMENT

----- by Arthur S. Einarsen

The Wildlife Management Institute,  
Washington, D. C., \$4.00  
232 pp., 70 illu.

THIS treatise fills a long-felt need in our knowledge of wildlife. It is not only a book of facts about the pronghorn, but it is fascinating reading and will delight everyone interested in wildlife. Mr. Einarsen's treatment of his subject sets a precedent in the interpretation of wildlife research.

The first chapter deals with the prehistoric history of the pronghorn antelope, its distribution and abundance. Historical records are enumerated, and the subject of migration is discussed. Relative to his field work Mr. Einarsen says, "Few may feel that winter days of study on the pronghorn range could be pleasant, but I assure you it was a happy occupation. The smell of the sage and the throaty, high-pitched *ka lank* of the raven still linger on. How dull will be the world when isolation is no more and we cannot watch these wildlings in their natural habitat. A lifetime cannot be better spent than to defer this day."

Chapter two contains the main body of the book and gives a clean and concise life history of the pronghorn, along with its characteristics and peculiarities. The structure and formation of the horns, hair, and hoofs are given in detail. The range of vision, as the author points out, exceeds that of a horse. A pronghorn can see moving objects between three and four miles away. In his records of speed achieved by the antelope, Mr. Einarsen shows that the pronghorn has no difficulty in accelerating up to 50 miles an hour and that individuals have been recorded as doing 70 miles per hour.

A list of the various kinds of vegetation consumed by the animal is given, with the scientific and common names. The newborn is traced through life to old age, and the pictures of the early development of the kids are unique.

## THE NATURE LIBRARY

Seton: Animals 295 pages 64 kinds; Blanchard: Birds 257 pp 124 kinds; Rogers: Trees 291 pp 226 kinds; Blanchard: Wild Flowers 270 pp 170 kinds; McCurdy: Garden Flowers 311 pp 400 kinds; Wood: Butterflies 286 pp 109 kinds. 48 color plates per book, 8 1/4 x 5 1/2 in. Price \$3.00 each, 6 v. set \$12.95. Remittance with order, full refund if returned in 5 days.

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The third chapter is entitled "Pronghorn Antelope in Relation to Civilization" and discusses the competition with domestic stock for the open range. The most serious conflict, the author points out, has been in the use of water. The antelope has not been accused of using the range to a point where domestic cattle are placed at a disadvantage.

The fifth and last chapter is for sportsmen and tells how to hunt the antelope, with discussion of suitable ranges for effective shots.

The book is beautifully illustrated with unique photographs and drawings by Shirley Briggs.

GEORGE G. GOODWIN.

## HENRY DAVID THOREAU

----- by Joseph Wood Krutch

William Sloane Associates, \$3.50  
298 pp.

THE author of this book teaches in Columbia University, where he is Brandes Matthews Professor of Dramatic Literature. He has written eight or ten books, perhaps the best known being his biography of the English lexicographer, Dr. Samuel Johnson. This book on Thoreau is one of an American Men of Letters Series, another one of the series being *Edwin Arlington Robinson*, by Emery Neff.

Professor Krutch is a well-known student and admirer of Thoreau without the hysteria prevalent in some quarters. We looked upon Canby's *Thoreau*, published nearly ten years ago, as more or less a definitive biography, but it seems that students of Thoreau's personality and philosophy feel that the story must be retold periodically. Anyhow, new books on Thoreau appear rather frequently. A new book constitutes a new interpretation, often a significant one, and we should expect nothing else.

How different our outstanding literary naturalists have been! There is not a great deal in common among Thoreau and Burroughs and Muir—the first being primarily a philosopher, the second an interpreter and poet-naturalist, and the third a son

Continued on page 439

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of the wilderness, a dweller of the high mountains and glaciers.

A book on Thoreau should have been written by a naturalist, and this is the case here, for Professor Krutch is a naturalist with more than the ordinary legacy of wit and learning so necessary in analytical criticism. This new book is an excellent analytical study of the life and philosophy of its subject, a valuable addition to this literature. It is a thoroughgoing and serious piece of work, one that deserves and will receive wide study.

It seems certain that the work of Thoreau will never go out of date. Therefore, every good analytical study of this classic should be welcome, as this one will certainly be.

CLYDE FISHER.

## BIRDS OVER AMERICA

----- by Roger Tory Peterson

Dodd, Mead & Co., \$6.00  
342 pp., 80 illu.

WE are familiar with books by Roger Tory Peterson in which the text is mainly a supplement to the craft of his gifted brush and pencil. Now he takes on a new role, for in this substantial volume 80 pages are filled with reproductions of 105 top-notch photographs, all but one or two (in which the author himself appears) being his own.

The work is a collection of 25 essays

that deal informally with almost countless facets of North American birdlore. In the first, "Birds and I," he tells the story of how it all began. Then, in a style that flows as pleasantly as though it were not laden with significant, and even weighty, matters, he leads us through mature and sensitive discussion that answers a large proportion of any bird lover's questions.

What is the lure of the big list on a red-letter day of migration? How many individual birds inhabit the United States, and where are they most concentrated? How have birds fared since the discovery of America, and what are the downs and ups that have harried some to extinction while spreading a primrose path for others?

These and similar problems come in for attention by one of the keenest field ornithologists of this or any earlier period. He takes us nearly everywhere in our broad republic, by night and day, land and sea, through metropolises no less than the wilderness, and gives us a wise insight into the variety, temperament, behavior, and capabilities of birds.

Among a few slips or errors is the author's outdated belief that the "global total of all known species of animals, from the mammals down . . . to the minute protozoa, is about one million." Zoologists have generally accepted the data of Brues, who concluded in 1946 that the insects alone comprise more than

five million species and that they may number ten million.

R. C. MURPHY.

## ANIMALS ALIVE

----- by Austin H. Clark

D. Van Nostrand Co., Inc., \$4.00  
472 pp., 25 pp. of illu.

DR. Clark has long been known in both scientific and literary circles for his wide interest in many kinds of animals. In this book he has let his enthusiasm provide a delightful cement for a richness of information on the usual and the unusual in his favorite field. Single-celled protozoans and giant whales, the parasites, the predators—all fall neatly into their accustomed niches as the account unfolds. The sequence is ecological but the reverse of the customary, for the land forms, though more recent, are treated first, those of fresh water next, and the wealth of the sea last. This arrangement brings out the relationships of each to man and includes careful consideration of domesticated animals and the food chains that link all life together.

More than two dozen full pages are given to clear drawings of interesting forms. Most of these cite the scientific names as well as the vernacular, so that no ambiguity is possible. This practice is carried out also in the very full index, but

Continued on page 475

# Redwoods in China

The story behind the recent discovery of the only known close relative of the giant redwoods—a tree thought to have perished from the earth many millions of years ago

By RALPH W. CHANEY

Department of Paleontology,  
University of California

THE Fushun coal mines of Manchuria have provided a remarkably complete record of a redwood forest of past ages. Buried in layers of shale which alternate with seams of coal are many fossil needles and cones that have been preserved as imprints in the rocks. The twigs to which these needles and cones are attached were shed from redwood trees that lived in Manchuria tens of millions of years ago. Since that time, redwoods have disappeared from this part of China. In fact, until recently, we would have said that they had become extinct over the whole world except for a narrow strip along the coast of California and Oregon and in groves scattered below the western crest of the Sierra Nevada.

In 1944, a discovery was made by a Chinese forester in Szechuan that has profoundly altered our ideas of the history of the redwood in Asia and over all the northern hemisphere. When Tsang Wang came over the hills into the village of Mo-tao-chi, he was surprised to see a large tree growing in the valley east of the village. He would have been still more surprised if he had known how his discovery of this relative of the California Redwood would be received in the world of science.

Actually, he did not know what manner of tree he was seeing as he approached its buttressed base. It is no wonder that he did not, for his were the first botanically-trained eyes ever to view the Dawn Redwood, *Metasequoia glyptostroboides*. Although Chinese farmers have lived in this area for many

centuries, it is so remote from the more traveled routes across China that not even the botanical explorers of the past century had come this way to see it.

We are told that Wang at first thought this tree might be a water pine, for in other parts of China *shui-sa*, as the tree is known, is generally applied to the so-called water pine (or fir), *Glyptostrobus pensilis*. Such a mistake would have been natural, for the general aspect of the tree and its leaves is similar to the water pine of southern China. So Wang collected branches with leaves and cones and took them to his associates at the Division of Forestry in the Ministry of Agriculture at Nanking.

A comparison of these specimens with those of the true water pine showed marked differences in the appearance of the cones. The cones of *Metasequoia* had a general resemblance to those of the *Sequoias* of California.

Much puzzled by this strange combination of characters, the foresters took Wang's material to the authority on the trees of Szechuan, Professor Wan-chun Cheng of National Central University. Dr. Cheng at once realized that he had never seen or heard of a tree like this. Consultation with Dr. Hsen-hsu Hu of the Fan Memorial Institute of Biology confirmed his judgment that this was a tree new to science. New species of plants may frequently be found in unexplored regions, but to find a wholly new genus was surprising to these Chinese botanists and to botanists everywhere.

Fortunately Dr. Hu is a paleobotanist as well as a botanist. He had read a paper published in Japan during the war, an article that had recently been sent to China but had not yet been read by paleobotanists elsewhere in the world because of interruptions of communications. In this paper a Japanese botanist, Shigeru Miki, had established a new genus, *Metasequoia*, for certain fossil redwoods in Japan. These differed from redwoods of the *Sequoia* type in that they shed their leaves seasonally and bore their cones on long naked shoots. The leaves that Wang had brought back from the living tree





Courtesy of Dr. H. H. Hu

▲ THE FAMOUS DAWN REDWOOD at Mo-tao-chi—sacred to the local inhabitants as indicated by the shrine at its base, venerated by science because it represents a holdover from the age of the dinosaurs

MEASURES ARE NEEDED to protect the Redwood from extermination in its native modern homeland in central China. The day before the author arrived, one of the trees had been felled for lumber

➤ DR. RALPH W. CHANEY at the foot of one of the trees, examining the twig and cone. The tree attains a height of at least 146 feet and a diameter of 7 feet



in Szechuan likewise had deciduous leaves, and the cones were identical with the fossils described by Miki. Here, in a sense, was a fossil that had come to life—a tree that was thought to have disappeared ages ago but was actually surviving in the hidden valleys of central China.

These trees were soon found to be living not only in the valley of Mo-tao-chi but in other adjacent valleys across the border in the Province of Hupeh. Using funds sent to them by Dr. E. D. Merrill, of the Arnold Arboretum of Harvard University, who has long been interested in the trees of China, Hu and Cheng sent out two assistants to make additional collections. In 1947, one of these young men, C. T. Hwa, found in the valley of Shui-sa-pa, to the south of Mo-tao-chi, several hundred trees of *Metasequoia* growing among the rice paddies or in adjacent ravines. Hwa brought back an ample supply of viable seeds, which were sent to Dr. Merrill, to me, and to others in the United States. When I received a portion of these seeds, the reality of this new tree so impressed me that I decided to visit it in its

► UNLIKE THE COAST REDWOOD, the Dawn Redwood sheds its leaves seasonally. Seeds have been obtained from this tree and sent for planting to many parts of the world

native home. I wanted to see how it lived and with what other trees it was associated.

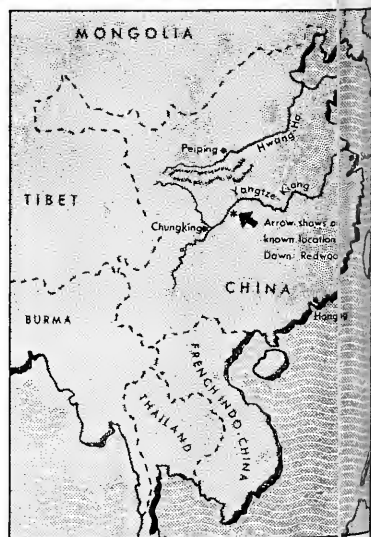
The details of the trip have been told elsewhere—how Dr. Milton Silverman, Science Writer for the *San Francisco Chronicle*, and I flew across the Pacific and up the Yangtze valley to Chungking, how we took a river boat down to Wan-Hsien and then walked over the steep and slippery trails for three days to Mo-tao-chi and for two days more to Shui-sa-pa. In March, at the time of our visit, the trees were bare of leaves, having shed them last November. Hanging from their branches were long catkins bearing the male cones, and the shorter female cones were also developing on the trees. We collected some of these cones for later study in America, but our immediate interest was in the environment of these close relatives of the California Redwoods and in the other trees that were growing with them.

The idea was gradually developing in my mind that it was fossils not of *Sequoia* but of *Metasequoia* that I had collected in Manchuria in 1925, at the end of a season with the Central Asiatic Expedition in Mongolia. If that were the case, perhaps other fossil redwoods I had found in many other parts of the world were likewise related to the newly discovered trees of central China. The key to our understanding of the ancient forests of the northern hemisphere might be found not only in the living Coast Redwood (*Sequoia sempervirens*) of California but in the groves of Dawn Redwoods (*Metasequoia glyptostroboides*) in Szechuan. If so, it was important to learn as much as we could about the climate and topography of the region in



which these "living fossils" had survived and to determine whether the trees now associated with them were the same sorts of trees as those living with them in the forests of the remote past.

These forests of other days made their first appearance about 100 million years ago, during the Cretaceous period, when dinosaurs were still living. They had become widespread in high northern latitudes—in Greenland, Spitzbergen, arctic Siberia, and Alaska—and lived on in this region as late as the Eocene epoch of the Tertiary period (40-60 million years ago), during which the mammals became well established. In addition to *Metasequoia*, which was widespread and abundant, the common trees of this





◀ A TREE of ancient lineage in a land of ancient lore. Its known distribution is restricted to a section only about 30 miles long

▼ IT IS HOPED that the Chinese, with their love of ancient things, will respect this most remarkable botanical rarity and aid its survival



forest were the birch (*Betula*), chestnut (*Castanea*), oak (*Quercus*), sweet gum (*Liquidambar*), beech (*Fagus*), and a tree no longer living in North America and now confined to Asia, the katsura (*Cercidiphyllum*). This assemblage of trees belong to what is known as the Arcto-Tertiary Flora, because it originated in the Arctic during what is known as the Tertiary or Cenozoic era. By the end of the Eocene period these trees were beginning to migrate southward in North America and Eurasia, apparently in response to a trend toward colder and dryer climate. Of course, individual trees cannot move, but it is well established from the fossil records that there was a gradual southward shift of this forest during the ages following the Eocene.

In the Oligocene epoch, some 30 to 40 million years ago, all of these trees had become established in Oregon and down into California

on our side of the Pacific, and in Manchuria and Japan on the Asiatic side. By Miocene time (an epoch which lasted down to within about 15 million years of the present), Dawn Redwoods were growing as far south as Nevada. There is no record of *Metasequoia* in California at this time, but many other members of the Arcto-Tertiary Flora were common there and elsewhere in the United States, and some of them, such as the alder and maple, have survived down to the present. In China, the only known forest during the Miocene period (represented by the Shanwang flora of Shantung Province) contained many hardwood members of the Arcto-Tertiary Flora, but *Metasequoia* has not been reported. However, it is known to have been living in Japan during the Miocene and also in the Pliocene epoch which followed. Elsewhere in the world, the Dawn Redwood had largely

disappeared, for the Pliocene was a time of cool climate with greatly reduced rainfall. Before the beginning of the Ice Age, following the Pliocene, *Metasequoia* had disappeared even from Japan. No fossils of the Dawn Redwood have been found anywhere in the world in rocks younger than Pliocene. And this tree was considered to have become completely extinct until it was found living in the interior of China. Here, and here only, it appears to have continued to exist for the past several millions of years, a "fossil" that has managed to survive in a world elsewhere unfavorable.

Summarizing the evidence of *Metasequoia* distribution, we find that it appeared at high latitudes in the Cretaceous period, was widely distributed there in the Eocene,

had moved south and was abundant in the United States and northern China in the Oligocene, was more scattered in distribution during the Miocene, and disappeared from the fossil record on both sides of the Pacific before or during the Pliocene period. Why has it survived only in central China after living so widely around the world in earlier ages?

This brings us back to the valley at Shui-sa-pa, where Dawn Redwoods are living under what appear to be natural conditions. When I was there last March, as I say, all of the hardwoods as well as the Dawn Redwoods were without leaves, but I was able to recognize most of the common trees. Birch, chestnut, oak, sweet gum, beech, and katsura were among those living in immediate association, all typical members of the Arcto-Tertiary Flora. Their presence here with *Metasequoia* makes these groves more similar to the ancient forests of North America and Eurasia than any I have ever seen. So it is important to learn as much as we can about environmental conditions in these valleys of central China. It will tell us what Manchuria and Oregon looked like 40 million years ago and will restore for us the terrain in Greenland and Alaska as far back as 100 million years ago. Observations on the existing climate in the area now occupied by Dawn Redwoods will enable us to make some long-range weather predictions in reverse regarding the rains and winds of Manchuria and Oregon in the days when *Metasequoia* lived there and left behind its leaves and cones to be preserved as fossils.

Our stay last March was too short to permit other than preliminary studies. Furthermore, there are no climatic records from any region nearer than Chungking, which is lower in altitude by about 3000 feet. However, we learned enough about the climate at Shui-sa-pa, at an altitude of about 4000 feet, to make some suggestions. Winters are cool and rainy, with temperatures rarely falling below freezing but with conditions not well suited to plant growth. Rainfall is abundant, much

of it falling in the summer. The climatic regime of summer rainfall and of unfavorable winters is now to be found widely in north temperate regions, where trees bear their leaves during the summer and shed them in the winter. The deciduous habit of the Dawn Redwood and of its hardwood associates seems to have been developed in past ages in regions with summer-wet and winter-cool climate. Why, then, is the Dawn Redwood no longer widely distributed as it was in the past?

No final answer can be given until further studies are made by Chinese botanists. I hope to go back to central China myself in the near future, to help further unravel the mystery of the nearly world-wide extinction of the Dawn Redwood and of its survival here in the valleys of Szechuan and Hupeh. I can now make only a few suggestions to help explain the wide differences between its past and present distribution. There is probably no other place in the world outside of the tropics where a mild, uniform climate is combined with a summer rainy season. In the southern United States we do have wet summers in the region occupied by a close relative of *Metasequoia*, the swamp cypress (*Taxodium distichum*), but the winters are cold, with temperatures regularly falling below freezing. In California we have mild winters in the region occupied by another close relative of *Metasequoia*, the Coast Redwood (*Sequoia sempervirens*), but the summers are dry. The same may be said of all parts of temperate Asia I have visited; mild winters characterize regions with dry summers, while in places where the summers are wet, the winters are cold. If it were not for the ranges of mountains that surround Mo-tao-chi and Shui-sa-pa, the winds from North China would come down during the winter and make these valleys too cold for the Dawn Redwood. And the hot summer winds from the north and west would make them too dry. These mountains were built during the Pliocene epoch, when *Metasequoia* was disappearing from other parts of the world. They have

preserved in this limited area the climate on which the existence of the Dawn Redwood depends. If for any reason the climate here were to change, they would probably become extinct in these valleys, as they have in all other known parts of the world.

We cannot control future changes in climate, but we may be able to help prevent the immediate extinction of the Dawn Redwoods from other causes. This is a region where fuel and timber are scarce, where even the land occupied by trees may be required for agriculture. The day before we reached Shui-sa-pa, one of the largest trees had been cut down to provide timbers for building a barn. A few weeks earlier another large tree had been chopped down, and we found it lying on the ground near a village, being used for fuel. Some immediate means must be found to protect at least a few of these ancient trees, which tell so much of the earth in past ages.

Word has come from China that a *Metasequoia* Conservation Committee has been organized. It is headed by Wong Wen Hao, formerly the Director of the National Geological Survey of China, a man who was a leading statesman during the war and has recently been appointed Premier. The great scholar Hu Shih, formerly Ambassador to the United States, now Chancellor of Peking National University, is the Honorary Chairman of the Committee. Its other members include outstanding scientists and officials of China, as well as Ambassador J. Leighton Stuart and two other Americans. With such leadership we may hope not only to save the Dawn Redwood but also to see the birth in China of great conservation organizations like the Save-the-Redwoods League and the National Park Service of the United States. Perhaps China is on the verge of moving to preserve many areas of scientific and historical value, of which the groves of Dawn Redwoods are only one. If these ancient trees are to survive into a future epoch of earth history, immediate steps must be taken to protect them.



One of man's oldest and most relished foods  
is also a fascinating subject of conversation

IF you ask a New Jersey oysterman who ate the first oyster, he will solemnly tell you that the brave deed was performed by an American Indian. This particular Indian, the sea farmer will explain at length, one day saw a peculiar looking "stone" in the water. He reached for it—and *snap!* The oyster closed its shell on the Red Man's tempting finger—very hard. The warrior immediately smashed open the oyster with his tomahawk,

bruising his fingers in his impetuous haste. Sticking his fingers into his mouth to alleviate the pain, he discovered to his surprise and pleasure "the delicious flavor of New Jersey's finest natural gift to man."

There may be some essence of truth in this story, though it recalls to mind the misfortunes of Lamb's famous character who discovered the delights of roast pig in a somewhat similar manner. But actually, people were eating oysters long

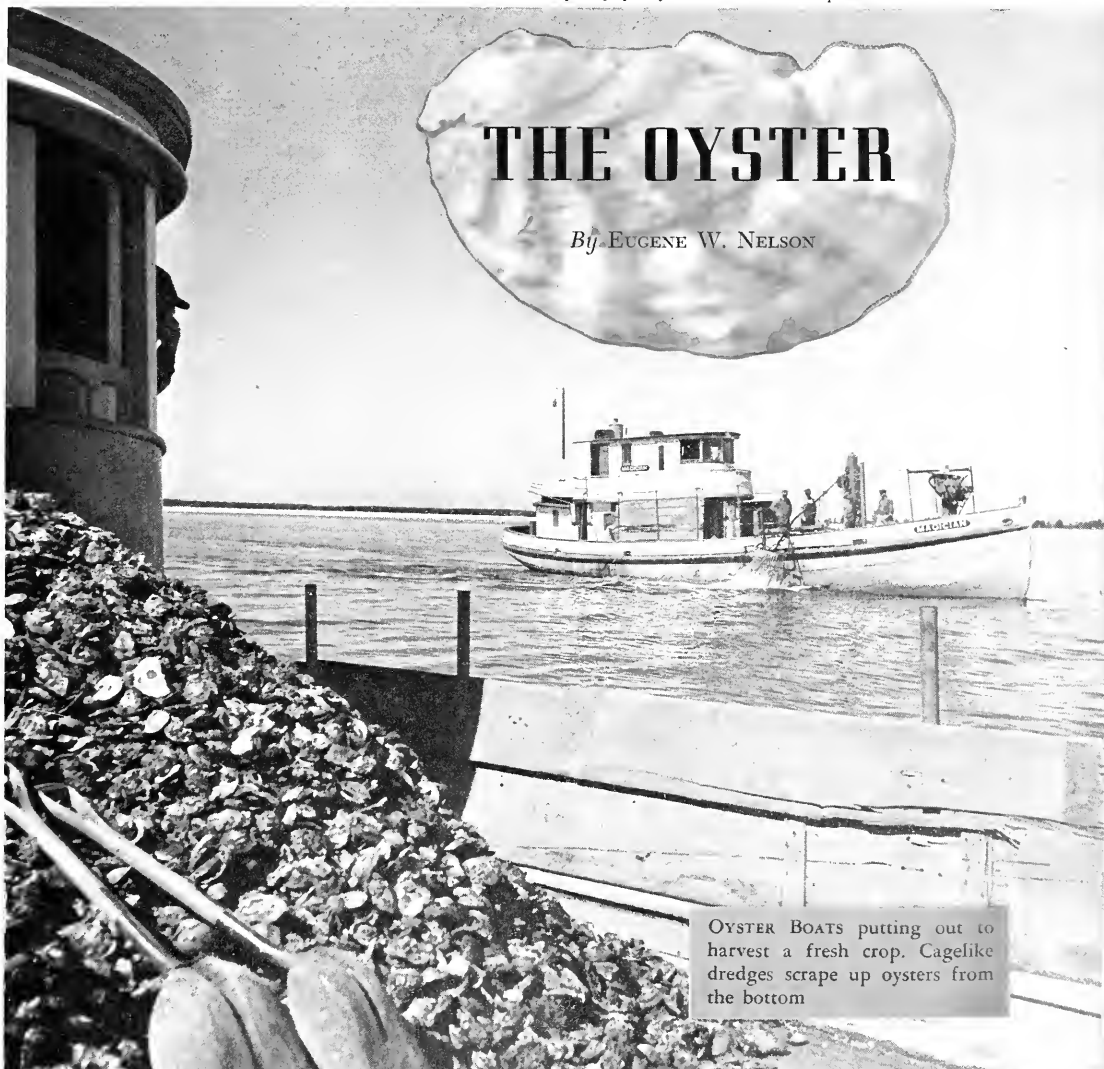
before the Red Men made their way to the eastern coast of the United States—unless the Indians migrated eastward much earlier than is now commonly supposed.

The custom of eating oysters has been popular for a long, long time, and figures from the oyster industry indicate that in this country, at least, our appetite for these extremely nourishing bivalves is steadily increasing. Mounds of oyster shells in the northern part of Europe testify that prehistoric man in that part of the world enjoyed this sea delicacy, and the same sort of mounds that the Indians left all

All photographs by CARROLL VAN ARK except where otherwise credited

# THE OYSTER

By EUGENE W. NELSON



OYSTER BOATS putting out to harvest a fresh crop. Cagelike dredges scrape up oysters from the bottom

along the Atlantic coast prove that they, too, were avid oyster-eaters.

The Romans were so fond of oysters that their poets turned out some fairly creditable lyrics in praise of them, and for hundreds of years after the Roman conquest of Britain, Roman and British fishermen vied with each other as to whose breed of oysters was the tastiest. The Romans didn't stop at just *eating* the oyster, however. They had many uses for his home, as well. They used oyster shells for medicine and also for cement. Cuttlefish bones and oyster shells were reduced to a fine powder and then used as a cure for wounds and ulcers—and even as a tooth powder. Palladius recommended a cement compounded from figs, pitch, and powdered oyster shells for repairing the famous Roman baths.

During the Middle Ages, too, oysters were in great demand, and it was in the sixteenth century that one of the most famous of all oyster legends was originated. An English country parson named Butler contracted—as nearly as we can learn from existing records—both dyspepsia and the gout. Consequently, his diet was restricted largely to barley water. Probably through

pique at his enforced dieting, he issued a solemn warning that oysters are unfit to eat during May, June, July, and August. In those days, parsons wielded a great deal of influence in matters both of the body and the spirit, so people heeded the Reverend Mr. Butler. His false pronouncement spellbound the world and continues to bind it today in the saying that one shouldn't eat oysters in those months that do not have an "r" in their names.

The real truth of the matter is that oysters are good the year 'round, although from May to September fewer are *sold* because this happens to be the spawning season. Conserving oysters during those months protects the industry for future seasons. In addition, oysters are slightly less palatable during the summer months, because they are either full of spawn (which gives them a flat taste) or else they have recently spawned (which makes them thick and stringy). Contrary to popular belief, however, oysters are as nutritious out of the "r" months as in, although they may not tempt the palate of the connoisseur at that time.

Oysters are animals belonging

to the "bivalve" division of the great group known as the mollusks. Oysters are called bivalves, of course, because all oysters have an upper and a lower shell hinged together along one side. When an enemy approaches—and oysters have many enemies, chief of which are the starfish—powerful muscles pull the shells together. This "shutting up" is the animal's only means of defense but a very effective one, considering the hardness of the shell.

Our word for this shellfish—oyster—has not changed much since early times. It comes from the Greek word *ostreon* because of its bone, or shell, *osteon*. The Romans called it *ostrea*, and the French took the word and changed it to *oistre*. From there, of course, it was only a slight jump to the now familiar *oyster*.

Oysters have been under cultivation longer than any other shellfish and longer than any other water creature. A simple form of oyster cultivation flourished in China at a remote date—one authority claims as early as 30 centuries ago. Certainly by the year 100 B.C., the Romans are known to have developed some kind of oyster culture.

▼ A DREDGE-LOAD is hoisted on deck. For continued yield, oyster beds must receive attention just as a farm must



▼ AT DOCK, a mechanical conveyor is lowered to the deck, and the oysters are shoveled onto it



There are many species of oysters in the world in the temperate as well as tropical seas. However, they seem to do best in the moderately cool waters of temperate regions. The oyster of our Atlantic coast (*Ostraca virginica* Gmelin) is considered the finest in the world. This oyster has been introduced on the American west coast and in Japan, but attempts to introduce it in many other places have proved unsuccessful.

Our eastern Atlantic oyster is extremely prolific. It has been determined that an adult female oyster will discharge from 15 to 114 million eggs at a single spawning. Since an oyster normally spawns several times during the summer, a single female may pro-

duce several hundred million eggs a season. These eggs are discharged directly into the sea—as is also the male sperm—so fertilization is an extremely haphazard process.\* Five or six hours after fertilization, the eggs develop into free-swimming larvae which grow thin bivalve shells within twenty-four hours. The newly born oysters are so tiny that sharp eyesight is needed to see one without the aid of a lens. It is claimed that a bottle the size of a man's little finger will hold fully a million one-day-old oysters. If all of these oysters should live to the age of three years, there would be some four thousand bushels of the

delectable bivalves. Some oysters live 20 years or so.

Soon after the young oysters develop their bivalve shells, they settle upon objects in the water and cement themselves into place. The young oysters are known as "spat," and their process of settling is known among oyster farmers as a "spatfall." Usually a spatfall takes place on the flats between high and low watermarks, although under modern methods of cultivation much spat is now obtained at a depth of 30 feet or more. In the life of an oyster, the setting period is of prime importance, for should young oysters find no suitable place of attachment, they will die. As many as 15,000 spat have been known to cement themselves to half

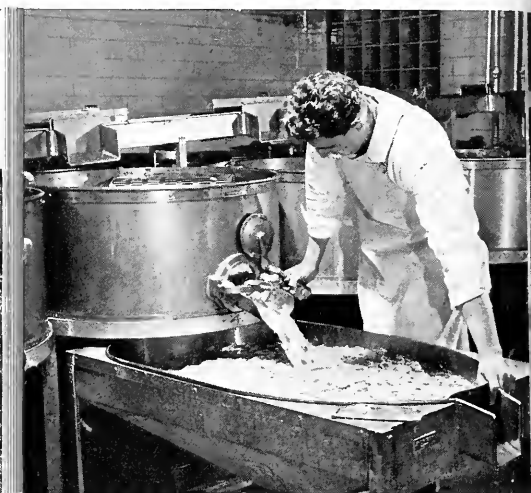
\* Certain kinds are self-fertilizing (hermaphroditic), for example *Ostraca edulis* Linné, of Europe.

▼ THE OYSTERS go directly into the plant and are usually shipped out the same day they are gathered





▲ DESPITE efforts to mechanize it, shucking is still done by hand. A good shucker can open 600 oysters an hour



▲ AFTER GOING THROUGH spotless washing tanks, some sucked oysters are packed in cans. Others are shipped "frozen fresh" Ben Sehl photo

a bushel of shells planted under water.

Spat soon develop adult organs and also start the process of feeding themselves. This the oyster does by drawing in water between its two shells—at an average rate of 25 gallons every 24 hours. From this constant stream of sea water, the oyster is able to filter out the microscopic plants and animals that constitute its food. This, of course, means that the waters in which oysters develop—under cultivation, of course—must be certified for purity by state officials. Also, oysters must have just the correct combination of fresh and salt water if the very finest flavor is to be obtained. If, during its eternal feeding process, a grain of sand or some other irritating object such as a parasite enters the oyster's home and cannot be forced out, the oyster begins to coat the offending object with the same material with which it covers the inside of its shell. In time, this process forms a pearl.

Today, in the United States, the commercial farming of oysters is based on many years of experience. Methods have been developed to control and meet unusual situations caused by climate, storms, and

enemies. And methods which will grow a well-conditioned and flavored oyster that satisfies the most critical taste are under constant consideration.

Oyster farming is a year-round activity, starting in the spring with the clearing of rubbish and foreign material from the "setting bottoms." This is usually done by dredging up the waste material, consisting of sponges, seaweed, shells, drills, and starfish. The drills, starfish, and waste materials are separated from the shells and destroyed on shore, while the shells are returned to the bottom to act as "cultch"—solid surfaces to which the larvae attach themselves when setting takes place.

A few mature oysters are then planted on the bottom to act as spawners. These oysters are observed from time to time to determine when they are ripe and when the temperature is high enough to start their discharge of spawn. Previous to spawning—or a little later during the larval free-floating period—the shells that were piled on the shore from the previous marketing season are scattered over the bottom for cultch, to provide the clean surfaces for the new crop to spat.

These shells are planted at the rate of about 1000 bushels to the acre and are ideal for this purpose, because their irregular surfaces induce small eddies around the shells to provide convenient harbors where the larvae can attach to the surfaces and make a home. Frequently, as many as 1000 spat may be counted on one cultch shell.

Conditions must be favorable during the reproductive period to prevent the free-floating larvae from being completely destroyed, either by the elements or by their enemies. Temperature is also an important factor in larval growth. A warmer temperature than the spawning temperature of between 65 and 70 degrees F. shortens the free-swimming period, and a colder temperature increases it. The larvae are unable to develop at much below 65 degrees F. and will die if held here very long. Severe storms, heavy rainfall, and the many enemies that love the succulent meat of the oyster are a constant worry to the oyster farmer.

As soon as the larvae set and spat is formed on the cultch shells, the sea farmer decides whether to leave them on the beds through the winter months or move them to deeper water where there will be

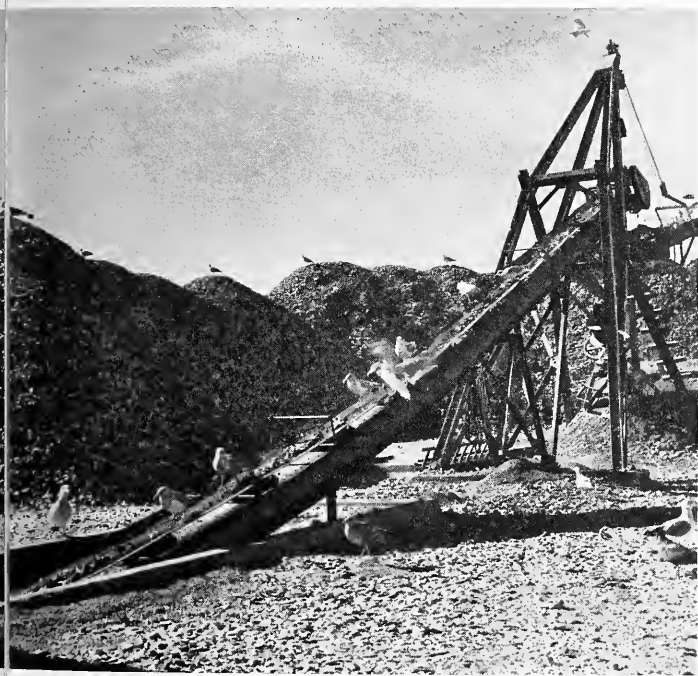
better protection from cold and ice and also from the enemies that lurk in the setting areas.

Whether they are replanted at this time or not, about 500 bushels of young oysters are apportioned to an acre of growing bed. They are left there to grow through the winter and at the end of the following summer are "thinned out" by transferring about half of them to other growing areas. This procedure is continued again the next spring or until the beds are thinned down to approximately 300,000 oysters to

oysters soon fatten into plump "meats." When this conditioning is completed, the oysters are caught up for marketing, in all kinds of weather—snow, wind, rain, sleet, or calm. If the water is covered with ice, a channel is kept open to the marketing beds. These conditions, naturally, represent many hazards, and so the sea farmer must have substantial boats completely equipped for operation and safety and manned by husky, experienced crewmen.

Here's how a typical oyster har-

▼ **THE SHELL PILE** is important in the oyster business. Many shells are planted in the oyster bed to aid the next crop. Others are used in roads and for chicken feed. These sea gulls use the conveyor as an escalator and cafeteria combined



the acre. The oysters remain on the transplanted oyster beds until they are between three and four years old and have reached a size and condition for fattening.

Then they are again transferred, this time to "marketing" beds, located mainly in shallow water where fast-moving currents of water carry along an abundance of microscopic food particles on which the

vest is carried out at the Bluepoints Company of Long Island, the largest oyster "plant" in the country. In the pale, predawn light of early morning, wooden-hulled boats about 75 feet long chug out from the plant to the marketing grounds. The captain gives the signal for a trial haul, and the crew drops a large iron-bound dredge over the ship's side. The steel teeth of the

dredge munch at the soil on the bottom of the sea and scoop up oysters, which are pulled back on board and dumped on the ship's deck.

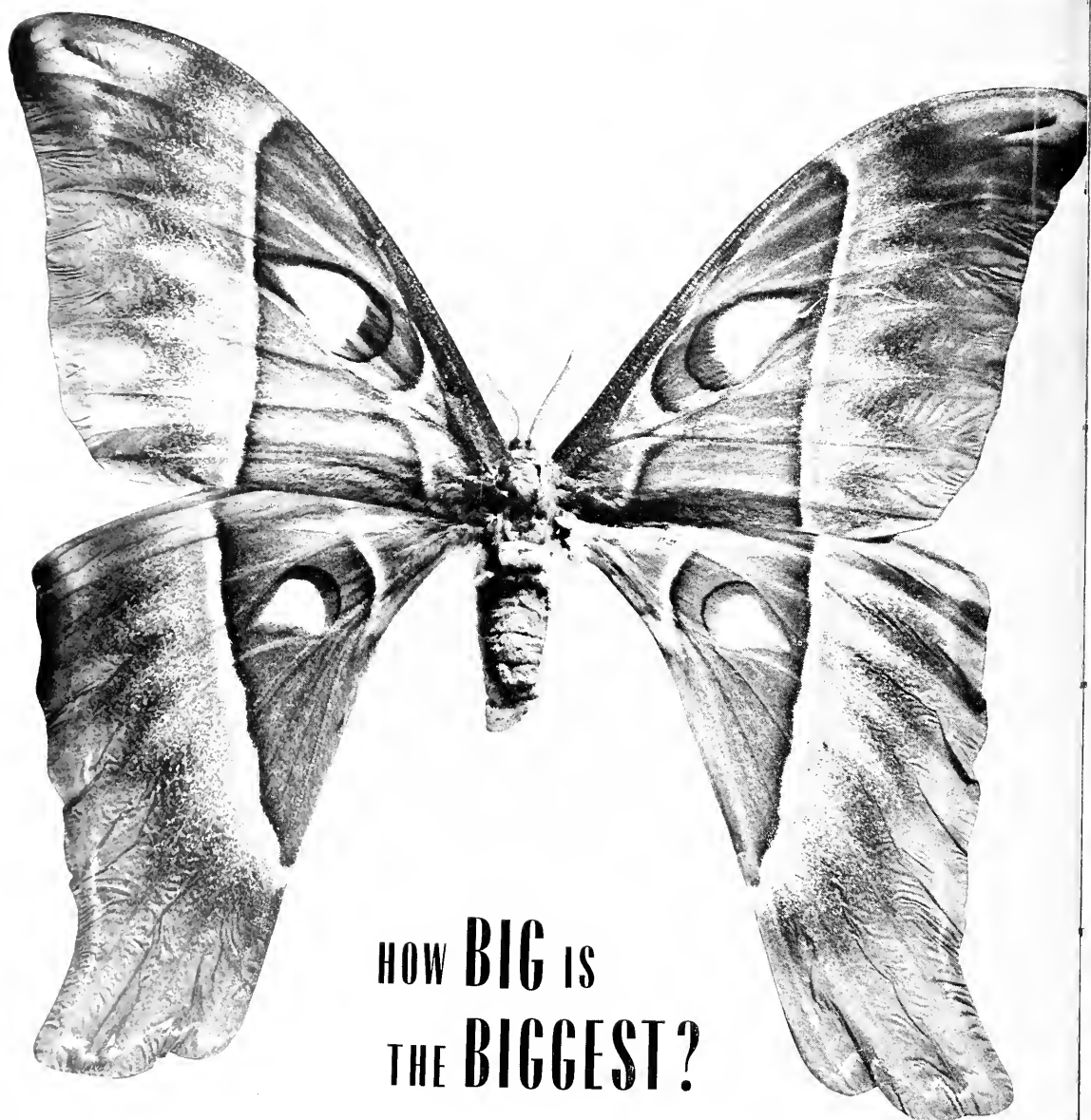
A good crew can load a ship by noon. Then the boats return to the plant and are unloaded by mechanical conveyors which are lowered right over each craft. The machines at the Bluepoints plant can unload 1200 bushels of oysters an hour.

The conveyor takes the oysters right into the plant and to the shucking department. Of course, a certain number of oysters are shipped with their jackets on, but the rest must be shucked. Shucking is still done by hand, although science has attacked this particular problem from many angles. There have been attempts to invent some mechanical method by which the delicate oyster meat can be removed automatically from between its hard, tightly-locked shells. Scientists have even tried to prepare chemical baths in which oysters could be soaked and so made to give up their treasures easily. But so far, no satisfactory method has been perfected, and the shuckers at the Bluepoints plant open oysters by giving them a rapid blow on the shell with a hammer and then inserting a sharp knife and prying open the shell. A skilled workman can shuck about 600 oysters an hour—something like 3 gallons.

Oyster meats are shipped both in the "fresh-frozen" condition and packed in cans. The shells leave the oyster plant on a conveyor, just as they entered. These shells, of course, are important to the oyster farmer since, besides being used as cultch, large numbers are ground up and used in the preparation of chicken feed.

Since sea water is extremely rich in all kinds of minerals, and since oysters feed themselves by straining food out of sea water, they are exceptionally rich in minerals and also in vitamins. Indeed, food chemists claim that oysters form a more nearly balanced diet than any other *single* item of food we have, with, of course, the exception of milk.





AMNH photo

## HOW BIG IS THE BIGGEST?

### *World's Largest Moth*

A wing span of fourteen inches is reported for Australia's "Hercules"—mammoth among moths

By F. A. LORD

PERHAPS even Mr. Ripley's pen hesitated for a moment and he wondered whether he'd believe it or not himself as he inked in a picture of a man aiming a shotgun at a moth flying above the jungle. The "big game" hunter was a naturalist belonging to a scientific expedition dispatched to Papua several years ago by one of the Rothschilds, and the moth was of a kind

NATURAL HISTORY, DECEMBER, 1948



◀ A LIFE-SIZE PHOTOGRAPH of a Hercules moth from New Guinea, closely related to the Australian subspecies which grows even larger. This specimen measures eight inches in width as mounted or about ten inches with the forewings extended normally at the sides. (*Cosinocera hercules hercules* Rothschild; presented to the American Museum by Frank Johnson)

believed to be the largest in the world. Scientists have named it *Cosinocera hercules*; Australians call it the Hercules or Atlas moth.

It's no moth to have fluttering around a candle, for its wing span commonly ranges from eight to eleven inches. The record specimen, which was found near the post office at the coastal town of Innisfail, in Queensland, Australia, measured fourteen inches from wing tip to wing tip. The Hercules moth is a close relative of the well-known Luna moth, whose genus stands next to *Cosinocera* in the classification of insects. It has four main subspecies, from Northern Queensland, German New Guinea, Louisiade Archipelago, and Dutch New Guinea respectively. The chief difference among these subspecies is in the size of the transparent spots in the wings.

The Hercules needs the humidity of the tropics, as dry heat hardens the casing of the eggs to such an extent that hatching is impossible. Consequently, it frequents the moist coastal belt of Australia between Ingham and Cape York in Queensland, and most of New Guinea.

To the male, nature has given hind wings of comparatively small area; they taper away sharply to become almost swallowtail in pattern, giving the impression of speed. It is different with the female; her task and responsibility are greater. Nature has given her the largest wing span possible, so that she may carry her heavy load of 200 or more eggs high about the jungle as she searches for trees with foliage that will later feed the caterpillars that emerge from the eggs. She favors Pana, Satinwood, and Bleeding Heart trees, and upon these she will lay her 200 eggs within 3 days. (Incidentally, the Bleeding Heart tree is so called because of the heart-shaped leaves that turn blood-red as they are about to fall.)

From the time the moth leaves

the cocoon until it dies, it does not eat. Its life span is about fourteen days, although this depends upon the time it mates. However, once her eggs are laid, the female soon dies, and there is something almost moving in the sight of her weather-beaten wings torn and frayed like some wind-tossed piece of crumpled brown paper. As soon as her tired body flutters to the ground, the jungle asserts its merciless law, and hordes of ravenous ants, which seemingly spring from nowhere, quickly devour it.

The eggs are laid on leaves, small twigs, or on branches of trees, and they are usually widely dispersed. In ten to fourteen days tiny caterpillars, about a quarter of an inch long, appear. They have black heads and hairy white bodies. As soon as the caterpillars appear, some eat portions of their shells before beginning to feed on the leaves about them.

They spend the next two months or so in eating and growing, until they are an inch thick and seven inches long—unless some hungry bird or aboriginal discovers them in the meantime. By now the caterpillar is quite a dandy, with a color scheme that would delight the most rabid designer of modern neckties. On a body that ranges from bluish-green to delicate grey run vivid red lines. Its legs are purple, and its black head has changed to green, striped with two yellow bands. Its spiracles or breathing holes are outlined with red; yellow spikes protrude from its body; and black triangles bordered with bright yellow have appeared upon its hind claspers.

The caterpillar, now fully grown, has reached the restless stage, and it seeks some suitable leaf in which to weave a cocoon around itself. The caterpillar binds the leaf firmly to a twig with silken thread to prevent the cocoon from being hurled to the ground by strong winds. Then it disgorges several miles of

thread, binding the leaf about its body and in three days encasing itself in a cigar-shaped cocoon four to six inches long. Five days later it changes into a chrysalis. Surprisingly, the period it remains in that stage before emerging as a moth may be anything from two months to two years.

Escaping quickly after its long imprisonment, the moth hangs quietly to develop and dry out its huge wings, which are warm and golden-brown with tear-shaped transparent windows. Though males and females emerge in fairly even numbers, the males usually appear first.

Reference books have given scant space to this gigantic moth of the tropics, and it has been left to two enthusiasts to make its unusual life known. Mr. Joseph Manski, Queensland entomologist, has submitted a valuable account of its life cycle to the Royal Entomology Society, and Mr. Len Simpson of Cairns, North Queensland, has spent nearly two years painstakingly filming the fascinating life of the Hercules moth in full color. The film possesses both dramatic interest and a peculiar beauty.

Because the moths only emerge from their cocoons between the hours of 10 P.M. and 3 A.M.—some say between 10 P.M. and midnight—weeks of patient night-watching were necessary for the camera to capture the whole story. Whenever a slight rustling was heard from one of the many cocoons suspended under the lights, the camera was hastily adjusted. This rustling, which may last five minutes, usually indicates that the moth is becoming active. But often the weary cameraman would only find that it was a false alarm, and while he was waiting expectantly, moths from other cocoons would have escaped, for emergence takes only a matter of seconds. Thus it went until he had his pictorial story complete.

When the moths emerge, the room becomes filled with the fragrance of the trees upon which they fed as caterpillars. This scent supposedly serves the females to attract their mates.

**N**EBUCHADNEZZAR was a great horned owl. He and Belshazzar spent the summer in my back yard, occupying a tenement next to Ananias, a big red fox. Nebuchadnezzar and Belshazzar certainly were good names for savage, lordly owls, and Ananias was not bad for a sly fox.

Since great horned owls are rare in the vicinity of Hanover, New Hampshire, I was lucky to get this pair. During the winter I had heard the weird calls of some owls as they hunted in a grove of pines about a half mile from the village. On a moonlight night in midwinter, I put on my snowshoes and ex-

When Nebuchadnezzar and Belshazzar were brought to town, there might have been a difficult feeding problem; but the parent owl found them and provided them with meat daily for six months

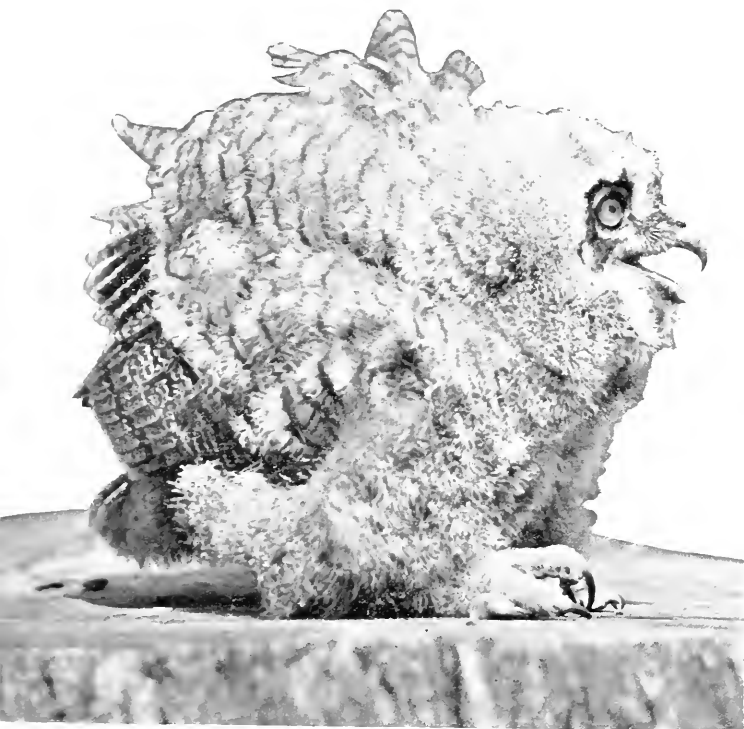


plored the grove hoping to find a nesting site, for I had read that these big birds start to make their nests while the snow is still deep on the ground. I carefully scanned the tops of the pine trees, but I found no sign of any nest building.

Late in the spring, however, a friend of mine discovered the nest in another grove about two miles

away. One young bird had tumbled to the ground, and we picked it up and put it in a bag; but another was in the nest, high up in the top of a big pine. Since I am not good at shinning trees, and since I had read that a great horned owl can put up a fierce battle for her young, I persuaded my friend to climb the tree and get me the other owlet. This he did without any damage to himself. Although the big owls did considerable threatening and scolding, they did not attack. We dumped the other owl in the bag and carried them both home.

My new lodgers were comfortably housed in a big cage by the woodshed door. Although they had the best of care, were well fed and never tormented, they remained utterly savage and untamable to the end of their stay with me. Every time I brought them their food they did their best to bury their cruel talons in my hand. They ruffled up their feathers and hissed and snapped their beaks at every visitor, but toward their near neighbor, Ananias, they showed a special animosity. This fox loved to sit on his doorstep, lick his chops, and gaze across the alleyway. All this offended Nebuchadnezzar; in fact, it drove him into a towering



◀ ONE OF THE YOUNGSTERS swearing at their neighbor, Ananias

# Owl Guests

By LELAND GRIGGS

*Photographs by the author*

passion. He snapped his beak with all his might and in his own language made dire threats as to what he intended to do to his tormentor. I wondered who would win if they came to a clinch, but, of course, I never let them do anything more than swear at each other.

A week after the arrival of the young owls a very strange thing happened; an owl we took to be the babies' mother discovered them. One morning at daybreak, I was startled to hear the hoot of an owl close to the house. I looked out the window, and there sat a great horned owl in an elm tree on the lawn. She held a rat in her claws. Soon she flew down to the cage and gave the rat to the young owls. From this day on, for nearly six months, she never once failed to bring a daily meat ration to the young owls.

Every evening at dusk, she flew into town, stopped in a clump of pines not far from my house, and called a low, soft hoot. If the young birds answered her, she flew up on the roof of my house, usually alighting on the chimney. She remained here for a few minutes, calling to the little ones below, and then she flew away and remained away until morning. Just at daybreak she returned with food, sometimes making more than one trip. These morning visits always produced a rumpus. All young birds are noisy at feeding time, and these owls were certainly no exception. The hoots and screeches sometimes lasted a half hour.

My neighbors enjoyed the evening call, and students from my classes often came and sat on my porch to witness the performance, but the early morning racket was usually greeted with curses from our end of town. I suspect the good and the bad effects must have been fairly balanced; at any rate, nobody asked me to get rid of the owls.

It is rare for a mother bird to hunt for her lost young. But it is also unlikely that another pair of parents should have found these birds and undertaken feeding them. I think it likely that, as the mother bird roamed over the countryside,

she heard her young, for they certainly kept up quite a squawking the first few days of their captivity.

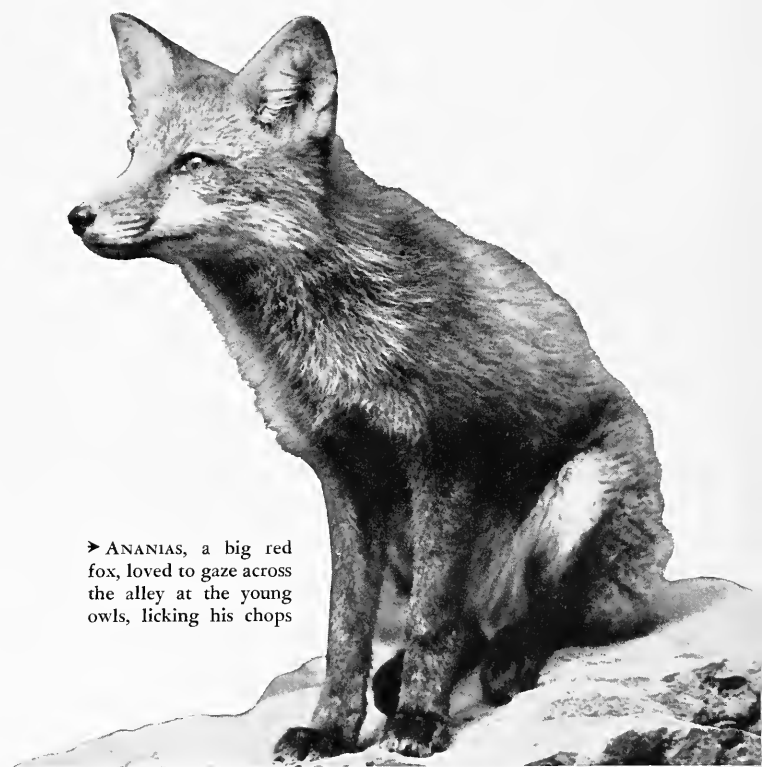
By midsummer my owls were as large as their mother and could have shifted for themselves if they had been free; yet the old owl never for a day diminished her careful attentions! She brought all they could eat until the first day of October, and then I saw her no more.

Once in a while both parents appeared, but this was rare, and apparently the larger bird, which may have been the male, never brought food.

I put a block of wood in front of the cage for the convenience of the adult owl while she was serving meals. She stood on this block and carved up her birds and animals. She reserved the brain for herself, provided she could crack the skull. The rest of the meat, in large chunks, was passed through the bars of the cage until the voracious appetites of the young were satisfied. Anything left over was

dropped on the ground or stored on the roof of my house. She not only abundantly supplied her own family but also, indirectly, the foxes that lived next door. In fact, I could also have had plenty of game for my own table. Her record for a single night—three trips—was a full-grown snowshoe hare plus two white leghorn hens, a total of about eight pounds of fresh meat of good quality.

For the first month her activities were mostly limited to the poultry market. She never bothered with mere chickens; she always brought full-grown hens, mostly white ones, weighing three or four pounds each. I kept a record of these transactions by marking a cross on the woodshed door for each hen brought in. When these marks ran up to 40, I rubbed them all out. For obvious reasons, I thought it might be better not to know too much about the matter. I got up early every morning and raked up the chicken feathers before the



➤ ANANIAS, a big red fox, loved to gaze across the alley at the young owls, licking his chops



▲ BIGGER THAN HIS MOTHER

neighbors began to appear. If by chance a passer-by asked too many questions, I told him that my owls never killed any chickens and that, of course, I could not be held responsible for anything the wild owls about Hanover were doing in the way of stealing chickens. This answer did not always satisfy the more curious of my numerous visitors. I once promised an especially irate old lady, who had a small flock of hens, that I was ready to pay for any chickens eaten by my owls, provided the original owner could prove property. Lucky for me, no one ever applied.

Later in the spring, when the suckers were running up Mink Brook to spawn, old mother owl

turned her attention to fishing. One evening, with a good pair of field glasses, I had a chance to see how she managed to catch her fish. She would run up and down the bank of the brook in great excitement until she saw a sucker close to shore. Then she would plunge into the water after it, but she usually missed it, for she seemed afraid of getting her feet wet. Only once, while I watched her, did she land her fish, and she immediately ate it on the shore of the stream. Before the sucker run was over, however, she brought to her young a half-dozen fishes which seemed to make a welcome change of diet for the owlets—as well as affording relief to the poultry men of the neighborhood. Great horned owls

are said to be destructive to the trout at fish hatcheries, and this I can believe, since penned up small trout must be much easier to catch than large, free suckers.

According to the bird books, great horned owls kill skunks. I can verify this by eight pieces of evidence. In the middle of August, mother owl went into the skunk business. Every night for seven nights in succession she brought in a fat young skunk; on the eighth night she hauled in what I took to be the mother of the young skunks—a rich find, six pounds of fragrant, fat meat. Most of this big skunk she stored away on the ridgepole of my house against the day when meat might be scarce. Lying there in the midsummer sun, this par-



▲ A SQUIRREL FOR JUNIOR, fresh from the country

ticular chunk of meat became very ripe. Any freshly killed skunk has its own peculiar odor, but a spoiled skunk exposed on a roof to the hot sun acquires, in a short time, an indescribable aroma all its own. Some of my near neighbors, I am sure, expressed themselves in rather different language. One man told a friend that he "wished to hell that damned owl would go back into the hen business." A man like myself who has worked in chemical and biological laboratories is fortunately able to take a more detached view of odors.

Once in a while a snake was brought in for breakfast, usually a small one that could be swallowed whole. Nebuchadnezzar literally drank his snake. First the head slipped down, then, little by little, the body slithered out of sight, leaving the tip of the tail sticking out for a few minutes, and then that, too, slowly disappeared. Where the snake actually went in this process was a problem I could never solve.

All this was a serious biological experiment on my part to determine scientifically the habits of the great horned owl and its place in the economy of nature. The diet was a varied one: rabbits, grouse, fishes, snakes, skunks, house rats, and flying squirrels. There is no doubt that this owl is very destructive to all sorts of bird and animal life. We should not be inclined to condemn it too hastily, however, for all the carnivores have a part to play in weeding out the weak and unfit and so directing the course of evolution. Albino birds and weak fishes that cannot make their way against the stream have no place in wild nature. In the long run, even the savage great horned owls play a wholesome part in nature's scheme of things.

By the first of September, Nebuchadnezzar had developed a voice—a melodious far-carrying bass—while his neighbor, Ananias, sang a good tenor. They combined to give us many a fine concert during the bright nights of the harvest moon. Their songs lulled me to sleep and reminded me of all my old happy hunting grounds, but, I



▲ A YOUNG KING OF THE WOODS. The owls remained savage and untamable until the end of their stay

regret to say, they did not always have that effect on the folks living next door. One morning, after an especially long concert, I overheard the man of the house remark to his wife, "We sure had one hell of a night last night." Sometimes the old owl happened by during such a concert, but her raucous voice usually ruined the harmony. It proved the bird books to be true—"The great horned owl can give out a blood-curdling shriek." The trio, thus formed, had great carrying power. It could be heard in Norwich, a village over in Vermont.

The faithful old owl made her

last visit at daylight on October first. On that day the hunting season opened in New Hampshire, and I suppose she was shot by one of the numerous hunters that filled the woods at that time. Since she had become fearless of man, she would have fallen an easy mark.

Nebuchadnezzar had outgrown his welcome, and the citizens of Hanover were losing their interest in my biological experiments. I sent the owls to the zoo in Boston, where the keeper rechristened them Daniel Webster and Rufus Choate, after Dartmouth's most famous alumni. I never saw them again.

Strange insects that keep the ants supplied with drops of honeydew. Intimate glimpses of the microcosm at your doorstep, supporting the argument that ants domesticate many more kinds of animals than man does

By EDWIN WAY TEALE

*All photographs by the author*

**H**UDDLED together like the huts of a village on the banks of a jungle stream, brownish tree hoppers cluster along the midrib of a sunflower leaf. Each is less than a quarter of an inch in length. Beneath my pocket magnifying glass, one of them expands into a fantastic insect camel, twin humps rising steeply above its back. Among these adults are the smaller, even more fantastic nymphs. Ridges and spines and knobs adorn their black-and-green bodies, so they resemble some creation of the glass blower's art.

Each year, during the latter days of summer, these insect clusters appear beneath the sunflower leaves of my Insect Garden. The brownish membracids are known to science as *Entylia sinuata*. Touch one with a fingertip, and it shoots into the air with an explosive snap before it unfurls its tiny wings and flies away. The "hopper" part of its common name has a sound basis.

Unlike camels of the desert, these insect camels are thirsty creatures. They spend much of their time with their sharp beaks inserted into the plant tissues, drinking from the well of sap that flows continually beneath their feet. And always around them the ants are busy. For, like the aphids, these particular tree hoppers give off sweet honeydew as a by-product of their sap drinking. Honeydew has been termed aptly "the national dish of the ants." Huber called it "ant manna." Every creature that produces it has ants in attendance. If the plant lice are, as Linnaeus declared, the milk cows of the ants, the tree hoppers of the sunflower leaf might well be called their camels.

These gregarious little creatures seem almost to have a family life. The female deposits her eggs in the plant tissues along the ribs of the leaf and then remains close by. Early writers on entomology even

# The ANTS'

thought that she "brooded" her eggs in the manner of a sitting hen. When the eggs hatch and the nymphs appear, the adult tree hoppers remain with them. Old and young live in close association. All are nourished by the sap of the leaf on which they dwell.



◀ HEAD of a carpenter ant, the kind that guarded and "milked" the tree hoppers





# CAMELS

For more than a week, in late September, I watched closely the life of one small colony of these insect camels. The cluster consisted of half a dozen adults and nearly twice as many nymphs. Beside them, I almost always saw one black ant and sometimes two. These ants



▲ CLOSE-UP photograph of one of the tree hoppers: *Entylia sinuata*



▲ ADULTS AND NYMPHS of the tree hopper cluster beside the rib on the leaf. These insects stay together until the nymphs are full-grown

belonged to the familiar gallery-making carpenter species, *Campenotus pennsylvanicus*.

When I swayed the stalk of the sunflower, gyrating the leaves, the ant guard paid no attention. This was something normal; the wind often swayed the leaves. But when I snapped the leaf smartly with a forefinger, the ant went into action instantly. This was something abnormal. Alert for enemies, it rushed about the leaf, starting and stopping with the suddenness of a figure in an old-time Keystone comedy. At intervals, it hurried back to the placid, sap-sucking tree hoppers, going over them hastily with its antennae like a shepherd count-

ing his sheep to be sure none is lost. Similarly, each time I photographed the leaf, the sudden, blinding stab of light from the photoflash bulb sent the ant racing about as if in search of a foe.

During the hours I watched events on the leaf, no real foe appeared to molest the membracids. Once when all the black ants were temporarily away, tiny brown ants swarmed over the leaf and feasted on the honeydew. But when I looked again, only a few minutes later, a carpenter ant was back on guard, and the small ants had disappeared. I found one later and dropped it on the leaf. Its whole frenzied effort was directed toward

escape. Perhaps the odor of the bigger ant warned it away. At any rate, although I placed it directly among the tree hoppers, where the coveted honeydew was thickest, it paused not for an instant but scurried off at top speed. I recalled another time when I dropped a carpenter ant on an aphid-infested weed where nearly a dozen large red ants were harvesting the honeydew. The carpenter ant ran the gauntlet of these red guards, dropping from leaf to leaf and harried at each new landing place, until it reached the ground and escaped. The tree hoppers of my sunflower leaf and the aphids of the weed apparently were considered the property of the ants in possession. They were the herds of the possessors—part of the food supply of the colony.

This property sense of the pastoral ants reaches a climax in their dealing with the plant lice. Among the twigs of a dogwood tree, you sometimes see small masses of earthen material. They are the product of the *Cremastogaster lineolata*

ants. They are little barns or cattle sheds built to protect the aphids massed along the twig within. Even more amazing is the sequence of events that insures a steady supply of aphid-honeydew for *Lasius americanus*. These ants have as their cattle the corn-root aphid. In the autumn, they carefully collect the tiny eggs of the aphids and store them away within the protection of their nests. When spring comes, they place the newly-hatched plant lice on the roots of smartweed or foxtail grass. Here they obtain sap until the corn plants are well established in the fields. Then the ants dig up the plant lice, carry them in their jaws to the corn hills, dig down and place them where they will be well fed and will produce honeydew throughout the summer months. This series of events, observed time after time by research scientists, enables the *Lasius* ant of American cornfields to obtain an ample supply of honeydew.

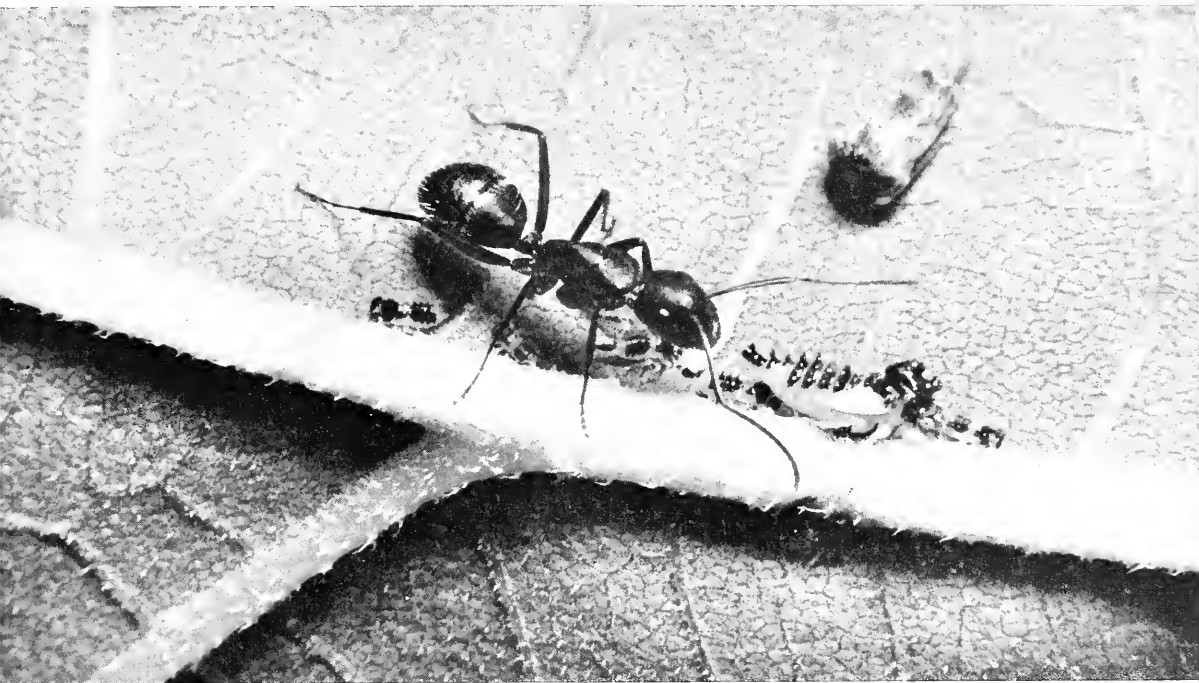
More than 100 different kinds of insects produce this sweet fluid. They range through such diverse

groups as the lantern flies, the jumping plant lice, the scale insects and mealy bugs, the tree hoppers, the aphids and the caterpillars of the lycaenid butterflies, the familiar "blues" and "azures" of spring and summer days. No less than 65 species of these caterpillars are attended by ants. In northern states, the ant's chief source of honeydew is the aphid. In some parts of the tropics, however, it is the tree hopper. Thomas Belt, in *The Naturalist in Nicaragua*, tells of ants that guarded membracids against the attacks of numerous enemies. He believed, in fact, that several species of them might have become extinct but for the protection afforded by the ants. Because tree hoppers are abundant only in the tropics, scientists have had less opportunity to observe their role as honeydew-producers for the ants than they have the activity of the northern aphid. William Morton Wheeler, in his classic work on the ants, observes that "the relations of the ants to the tree hoppers are but little known."

On my sunflower leaf, the carpenter ants did more than lick the honeydew from the surface. They

▼ A CARPENTER ANT of the species *Camponotus pennsylvanicus* guarding a cluster of tree hoppers on the sunflower leaf





▲ THE ANT preparing to "milk" one of the tree hopper nymphs by stroking it with its elbowed antennae

actually milked the membracids. Day after day, I watched the guarding ant go over the cluster of strangely-formed insects. With its elbowed antennae, it carefully stroked them, inducing them to give off drops of the sweet glutinous fluid. It passed from one insect to the other; it stroked both nymphs and adults. Sometimes it gave only a stroke or two. At other times, it continued the milking process for half a minute or more. Around the world, *Camponotus* ants and others stroke their cattle with their antennae to milk them.

In the case of aphids, researches have shown that the plant lice that are milked in this way suck larger quantities of sap than those that are not attended by the ants. In the course of a single day, one aphid was observed to give off 48 drops of honeydew. Sometimes a plant louse will produce drops of sweet fluid for several different ants in succession. While the aphids nor-



▲ THE ANT MILKMAID AT WORK. The tree hoppers often scatter out along the ribs of the sunflower leaf, drawing into a cluster again later on



▲ ANT, ADULT TREE HOPPER, AND NYMPH beside a rib of the leaf

mally shoot the sticky liquid a little distance from their bodies, when they are stroked by the ant milkmaids they give off the drops slowly. In fact, some of the aphids that have been associated with ants for millions of years have a little circlet of stiff bristles that conveniently holds the honeydew drop until the ant can take it.

Another adaptation that, according to Dr. Wheeler, may be a consequence of the long association of ants and honeydew-producing insects is the distensible crop of the *Camponotus* ants. Considerable quantities of honeydew can be stored in the crops of these ants. The famous honey ants of the southwestern deserts carry this ability to the extreme. Certain members of the colony become mere storage bags, hanging from the ceilings of the nests with their bodies distended into honey-filled balls. Such ants, in former times, were served as a special delicacy at wedding feasts in certain parts of Mexico. Under normal conditions within the nest, the sweets they contain are regurgitated and fed to other members of the colony during the dry season when food is scarce.

This passing of food from one

member of a colony to another on demand is a characteristic of all ants. Years ago, an experimenter tested this by feeding some ants with honey that had been given a brilliant color with aniline dye. These ants had transparent abdomens that revealed the color of the food consumed. Before the day was over, scores of other ants were running about with their abdomens also tinted the same color. The food originally eaten by the few had been passed from ant to ant until many in the colony were being nourished by the tinted sweet. The ants are well described as having a "social stomach."

I noticed oftentimes that when a second carpenter ant joined the one on the sunflower leaf beside the clustered tree hoppers, it would approach the first insect, thrust its jaws close, and receive some of the harvested syrup. The first ant, instead of traveling back to the nest with the collected honeydew in the manner of a bee returning to the hive with nectar, was passing the food on to other ants as they reached the leaf.

It seemed to me, as I watched the events taking place on the leaf, that most of the work of guarding and

milking the herd of membracids was being done, day after day, by the same carpenter ant. Was it the same or did it just look the same? I daubed it with a bit of white enamel. It lost its hold and tumbled into the grass tangle beneath the sunflower. All that day, the tree hoppers remained unattended. But the following morning their guardian was beside them once more. One side of its inky black abdomen was gleaming white. It was a marked insect that could be recognized as far as I could see it.

Nights, when I went to bed, this insect was on guard. Mornings, when I got up, it was still there—sometimes motionless and apparently sound asleep. Did it remain beside the cluster of tree hoppers all through the hours of darkness? Between two and three o'clock one morning, I crawled from bed to find out. Houses stood white and silent in the moonlight. I ran the beam of my flashlight along the sunflower leaf. There was the painted ant, clinging in place beside its charges. Occasionally, during the day, it was relieved by other ants. It would disappear for an hour, sometimes for half the day. But, in the main, the herd of insect camels seemed to be in charge of the ant I had marked.

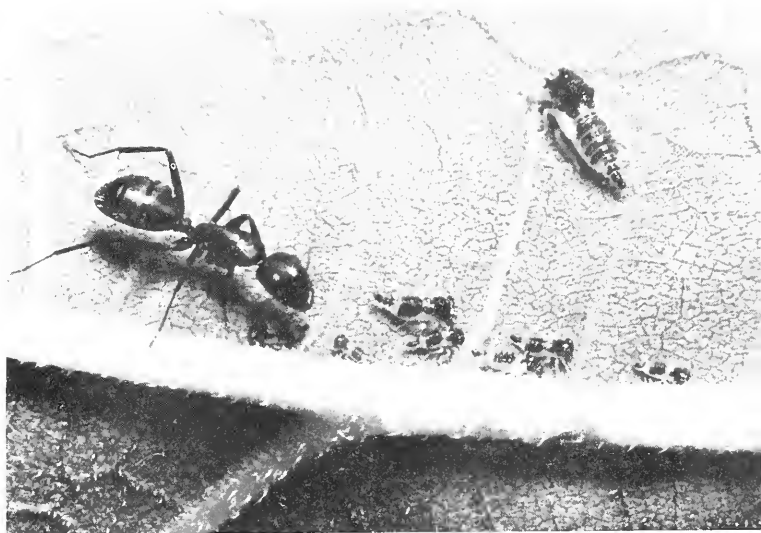
Ants have been protecting and milking insects that produce honeydew for ages. Fossil ants and fossil aphids have been found together in Baltic amber millions of years old. By collecting the honeydew, ants benefit not only themselves but also the insects from which they collect it. The fluid is sticky and, if not removed, would impede the insects that give it off. Thus the work of the ants, in tending their varied herds of cattle, is mutually beneficial.

As for the plants, the ant probably benefits them by helping to rid the leaves of a varnish of honeydew that would otherwise clog the pores and hinder respiration. But, as with most social phenomena, the

results of this co-operative existence are not always 100 per cent beneficial to all. A variety of fungi and other plant diseases can be spread by the ants visiting the aphids, including sugar cane mosaic, plum fungus, fire blight, and melon wilt.

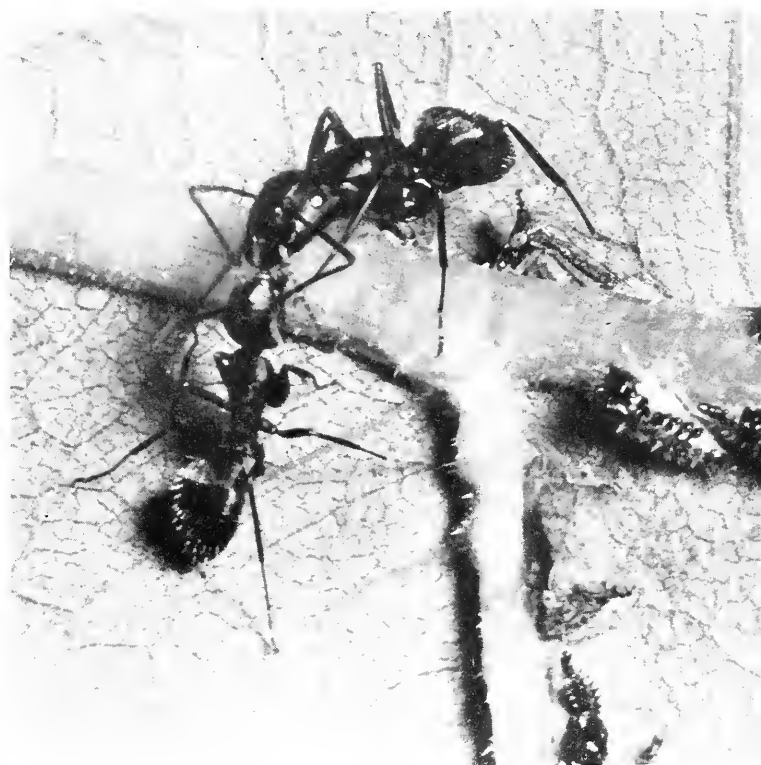
Other insects—a strange array of them—are also found in association with ants. More than 1500 species of small creatures (fully 1000 of them are tiny beetles) inhabit the nests of various ants. Some are parasitic, some are tolerated boarders, some are guests, and some even seem to have the status of pets. Most of the latter give off aromatic secretions of which the ants are fond. Naturalists have seen these living sachet bags being carried about in the jaws of ants. At other times, they have been seen riding around on the backs of ants for hours at a time. One small beetle that makes its home in anthills was found by a scientist in Europe to be giving off a secretion containing pure iodine. All told, the number of creatures that may be said to have been domesticated by the ants far exceeds the number domesticated by man.

During the latter days of September and the early days of October, the cluster of membracids on the sunflower leaf began to break up. All were now adults. They began to drift apart, to move to other leaves. I watched the painted ant toiling laboriously from one tree hopper to another. The days of plentiful honeydew were over. In the first night of heavy frost, all of the strangely-formed little sap drinkers of the sunflower leaf would be numbed into painless death. A little later, the arrival of settled cold would send the carpenter ant into the galleries of its nest for winter hibernation. However, hidden in dry plant tissues, the eggs of the last of the membracid females would be safe, ready to produce a new family of these curious insect camels in the warmth of the following spring.



▲ ANT and tree hopper nymphs of various sizes. The eggs laid by the female tree hoppers hatch at different times, so nymphs in all stages of development are found on the leaf at the same time

▼ ONE CARPENTER ANT feeding another. This passing of food from one member of a colony to another is characteristic of all the ants



# Penetrating the Petal

*X-ray shadowgraphs show that with flowers, beauty is more than skin deep*

By LEWIS WAYNE WALKER

X-ray Shadowgraphs by C. J. WITKOWSKI

AN inquiring mind, medical training, first-class laboratory equipment, and an eye for beauty has enabled Dr. C. J. Witkowski to give his X-ray machine a pleasant recess from eying the innards of humans. At the same time, this combination has enabled humans to view flowers as they have rarely been viewed before. In reality, these pictures are shadowgraphs resulting from the passage of light through plant tissues and thence onto sensitized film. Texture, consistency, and depth, so different from flesh and bone, made considerable research necessary before successful results were obtained.

Dr. Witkowski's machine originally had a range of between 50,000 and 85,000 volts, a power that was far too strong for botanical subjects. So he constructed a special transformer to reduce the setup to about 15,000 volts. These weakened rays successfully penetrated the delicate petals and leaves but were stopped by the thicker twigs and branches, which registered as dark shadows.

Although the results are masterpieces of beauty, they have little scientific significance. But in the future—who knows? Perhaps mineral content, such as the iron in the spinach that is supposed to have made a man of Popeye, will be discernable to an X-raying botanist of tomorrow and thus open up new fields. At present, these shadowgraphs may give some debutante the inspiration for an evening gown.



*Rose*





*Calla lily*

*Carnation*




*Hibiscus*



*Moonflower*





◀ ITS GRACEFUL  
LINES and appealing  
ways endear the fairy tern to  
all who make its acquaintance

## The Fairy Tern

THE fairy tern, known also as the love tern and the white tern, is essentially a bird of the tropical oceans. By reason of its confiding ways and its charming habit of flying out from its chosen haunts as one approaches, to hover within a few feet of one's head in an inquisitive and apparently friendly manner, it has endeared itself to the residents on many lonely islands and to many who served their country in remote parts of the tropical oceans. Even the rough laborer engaged in construction work generally accorded this particular bird his respect and protection.

For the benefit of those not personally acquainted with this little gem among oceanic birds, it may be said that the fairy tern is about the size of a small dove. Its appearance is exquisitely delicate and gentle, with the long pointed wings and forked tail well known among other terns, or sea swallows. With the exception of a black ring around the eye and the brownish shafts of the primaries, its plumage is entirely white; and the bill is black for three quarters of its length, with the basal part blue.

This tern extends its range through the tropical parts of both

Puzzling questions concerning a bird that lays its egg on a branch and catches one fish after another until its bill is filled with them crosswise

By THOMAS M. BLACKMAN

*All photographs by the author*

hemispheres and breeds on numerous small and remote islands, including Ascension, Fernando Noronha, and South Trinidad in the Atlantic, the Seychelles and Chagos Islands in the Indian Ocean, the small islands of the Hawaiian chain, the Galápagos, Caroline, Marianas, and numerous islands in the South Pacific.

### The Balanced Egg

Most species of terns lay their two or three eggs on the ground, with little or no nest material. This bird, however, in common with most other tropical terns, lays only one egg. And while some other terns nesting in the tropics choose to build a very substantial nest among the branches of trees, the white tern lays its egg on a bare rock or, if trees occur in its breeding place, on the bare branch of a tree or bush wherever a slight depression may be found to render its rolling

off less likely. Often the egg may be found lodged in a fork of one of the thinner branches of a bush or tree, where it may be clearly seen from beneath. I once found one of these birds with its egg on the trunk of a fallen tree, only fifteen inches from the ground; but a position among bushes or in a tree, between four and fifteen feet from the ground, is more usual. Where coconut trees occur, as they do in many of this bird's haunts, the egg is said to be sometimes placed on the midrib of a palm leaf, just where, in curving over, the rib is horizontal; or on the top of a broken-off stem of a coconut tree 20 or 30 feet from the ground.

Rough winds sometimes occur during the incubation period, which at Midway Islands is in March and April, and there is reason to believe that many of the eggs are lost. On two occasions, I saw an egg fall to the ground simply when the bird



▲ THE HATCHING CHICK must be sure-footed to enter the world on a precarious perch like this

left it, and at another time the wind caused an egg to roll more than an inch down a slightly sloping branch until its progress was checked by a projection on the bark. I therefore resolved to put this matter to the test. After carefully recording the positions of 30 of the eggs, I visited the place next day. After 24 hours of moderately rough winds, 3 of the eggs were missing, and a careful search of the ground beneath disclosed fragments of the shells.

When newly hatched, the young bird is covered with buff-colored down and has a black mark above the eye. With its sharp little claws, it clings so tenaciously to the place where it was hatched that it is not easy to remove it without injury.

The parents feed the young bird little silvery fish about one inch and a half long, and they sometimes arrive with the bill loaded from base to tip with a dozen or more of these tiny fish held crosswise. It is perplexing how these birds and others having a similar habit are able to catch and hold a number of fish in this manner and con-

tinue to catch others without losing what they already have. Several writers have discussed this question, apparently without arriving at any full and satisfactory explanation.

Careful observation of the white tern when feeding its young, and the evidence of the accompanying photographs taken on Sand Island at Midway, appear to offer a better understanding of the way in which the feat is accomplished.

#### Photographic Evidence

Examination of the two pictures at upper right, taken about fifteen seconds apart, will show that the young bird is allowed to take the fish one at a time and that each one is passed down to the tip of the bill while all the others remain in the same position nearer the base of the bill. The same order prevailed, right up to the end of the meal, on each occasion when I witnessed the feeding process. The third photograph was taken toward the end of the same meal, when the young bird had disposed of all

▼ A FORK in a branch or only a rough place on the bark is a nest for the fairy tern. It is said to lay its egg even on the midrib of a palm leaf



but four of the fish. One of them may be seen in the bill of the young bird, one in the extreme tip of the parent's bill, and the remaining two still held at the base. The young bird was fourteen days old at the time these photographs were taken.

The photographs show that the bird has perfect control over each individual fish and can pass it forward to the tip of the bill while retaining in their same positions all the others higher up. There is no reason for wonder, therefore, that after catching each fish, the bird is able to pack it away safely toward the base of the bill. This much seems to be satisfactorily shown by these photographic records; but beyond this we can only resort to conjecture. It appears obvious that the fish could not be passed backward and forward in this way without use of the tongue; and it seems reasonable to suppose that when the bill is opened to seize another fish, the bird may be capable of using its tongue to hold those in place that are near the tip of the bill.

The feet of the white tern are less fully webbed than those of other terns, and it is seldom seen to alight on the water. I never saw these birds fishing in the vicinity

of their home islands, but they may frequently be seen from the deck of a ship when passing these islands, flying singly or in twos and threes directly toward or from their homes. This leads one to think that they make regular excursions to their fishing grounds a few miles away. Strange as it may seem, fishermen who see them while on fishing excursions tell us that these birds catch their fish when the latter leap out of the water on being disturbed by the approach of larger fishes.

#### *Split-Second Timing*

After carefully observing the perfect control that the parent bird exercises in moving each fish forward in its bill for the waiting chick, the feat of holding several fish in its bill while catching more has appeared to me less remarkable than the speed, accuracy of aim, and perfect timing that must be necessary to catch the fish in the air, if such is really the case, and there seems no reason to doubt it.

Close to the islands we sometimes see great shoals of similar tiny fish swimming in close formation near the surface of the water in calm weather. At times, one part of the shoal after another suddenly leaps into the air on the approach of a larger fish, which on two occasions was identified as a small barracuda ten or twelve inches long. The sudden leap of so many small fish causes a thrashing noise somewhat resembling that made by beating the water with a leafy branch. Due to the suddenness of the leap and the prolonged disturbance resulting from the delayed action of partly detached portions of the shoal in joining the general movement, one has great difficulty in judging either the height or the length of their passage through the air. Apparently each fish is not out of the water for more than one second. They appear to rise only a few inches and to travel a very few feet before regaining the water. On those occasions, one gets a good idea of the speed and accuracy needed to catch one of those small fish in the manner attributed to the fairy tern.

THE FAIRY TERN



▲ THE BEAKFUL OF FISH are caught singly and fed singly to the young. The chick has taken the first fish, and the parent is preparing to "hand it" another from the tip of its bill



▲ THE SECOND FISH has now been moved forward in the bill without disturbing the others farther back. An agile tongue appears responsible

▼ LATER IN THE SAME MEAL. All of the fish except two have been moved forward one at a time to the end of the bill. When catching the fish, the process is apparently reversed. Fish already caught are held in place by the tongue when the bill is opened to receive another





◀ "ON RARE OCCASIONS, the sun shone warmly for a few moments, and we eased off our heavy sweaters and coats. The unexplored sea cave is roofed with daisy trees"



▼ "FUR SEALS are pugnacious and dangerous. Their odor is the worst I know in wildlife. Kelp edges this seething inlet, and lichens blanket the rocks"

WE are only a few score miles from New Zealand and the ways of civilization, yet in all our daily living we are a million leagues away.

Bob uses every daylight moment of days that slip by too fast, winning his knowledge of these storm-bound islands so aptly named the Snares. The discomfort of our living matters somewhat to us both, but the wondrous opportunity matters a great deal more.

Something happens every minute. Just now Charlie Fleming has brought in a bit of seaweed that looks like a necklace of green crystal beads, and Mr. Baird is talking with the mainland over the radio telephone he himself has set up. It has been comforting to know that "Alert" reached safety from out our ogre seas. Captain Black sent "regards to everybody, especially Mrs. Murphy," indeed a pleasant message. Alone with these nine men on their jobs, encouragement that perhaps I am carrying my own weight is not amiss.

Mr. Baird uses his electrical equipment in more ways than one; when a sea lion came too near, he ran out a wire and gave it the shock of its life. It has not returned.

The two Bobs came in excitedly early in our stay here to report four sea elephants of the South Georgia kind at the head of the inlet. One of the females looked as if she were about to have a pup. We found her later beside our tent



## A Naturalist's Wife

The culminating episodes in an ordeal of water and mud. Intimate glimpses of expedition life in a far-off world that was little known before this group of scientists visited it

By GRACE E. BARSTOW MURPHY

Photographs by ROBERT CUSHMAN MURPHY unless otherwise credited

door, and although she is harmless, her mate is not. Since this discovery, the men walk up with me after dark, but no other animals have come near. I asked Bob Falla if sea lions ever came into the tents, and he said nonchalantly: "Oh, yes." Bob Murphy found a spot at the back of the tent where I could get out if a sea lion came in at the front. I said:

"But I'd land in the penguin rookery," a place even deeper in mud than the rest of our muddy island.

"You'd not mind that if a sea lion were coming in."

Sloshing down alone from the tent, I saw a brown duck with its green wing feathers, walking in a troop of penguins. Thrilled, I rushed to the eating tent where the two Bobs were skinning birds, to tell them of the wonderful duck. Uninterested, they both remarked: "Oh, yes, it has been about for two or three days."

Those naturalists! They are so bottled up in their own findings that they haven't time to share with



common folk like me. Perhaps a go-between is needed to pass on details of this experience.

The duck is the New Zealand "gray duck," which we will see wherever we go—the commonest New Zealand duck.

The collections for our exhibit are growing. Everyone helps Bob, besides doing his own work. The detail and preservation of specimens must be meticulously carried out in order to present the Snares first to the preparators in the Museum and, through their work, on to the public. The few skins that comprise the collection are made up at the long table in the mess tent. The picture of the men working at it is in my thoughts to stay. Bob has felt very pressed for time, but as the days pass and the work is plowed through, he begins to breathe more easily and to feel that he can finish. The almost constant rain makes the essential color photography very difficult. When the sky lightens, and more rarely, when the sun shines through a rift even for a few moments, he rushes for stills or movies in Kodachrome. He

is probably building far better than he realizes and will have an excellent and typical series in color to take home.

While he photographs the colors, I send them through my pen: Of the great fern clumps, the thick, short, gray stumps are hidden by massed and overhanging dead, brown, shrivelled fronds. The long living fronds are hunter's green. The newly unfolded ones are hunter's green in the center, with a suggestion of brighter green about the edges. The curled-up tops of these are bright brown with a touch of gold. At the top and middle of the clump, the still unwound fronds are brown, with a hint of green along the stems as the leaves peek out on either side of the stringlike coverings.

The tiny-leaved, thick-growing flat plant that carpets the ground here and there around the mud-holes is the shade of fresh apple leaves in spring. Mosslike lichens, running from bright green to yellowish, grow in spots and splashes on the light-tan branches of the olearia forest, sometimes envelop-

ing these branches, leaving no gap whatever. The old leaves of these trees are the same hunter's green as the fern fronds. Yet this same shade is dull in the tree leaves and shiny in the fern fronds. The new leaves are a lovely silvery-whitish gray, a unique thing. On the undulating hills, these soft candle-like leaves lend a distinction to the foliage, which must be duplicated exactly if the exhibit is to give the idea of what this forest looks like in its late November spring.

The mud itself is never black, even though every one of us calls it "black mud." It is a very dark brown, tinging into a shade that approaches black. To understand this shade, one needs only to compare the really black plumage of the tomtit with the mud.

The trunks of the trees are tan without yellow, the lichens lending greenish tinge to even the smallest branches. No trunks are black, but some are spattered dark with mud. The leaves of the olearia are stiff and hard. The branches are bare up to each topping tuft of leaves; they keep their magnolia-like shape

## life in the Sub-Antarctic

▼ "R. C. M. is in his natural habitat with a lecture audience. He insists they look bored. The subject of his discourse is apparently motion-picture photography"

Photo by Robert A. Falla



➤ "THIS FEMALE SEA LION, or it may be a young male, is smaller and livelier than the huge bulls, which wallow and cry all over the island"



unbendingly, giving a wavy appearance to the hills, like swells coming over a harbor or small sea.

The muttonbird shrub, or groundsel, with its clumps of yellow daisies, has the same silvery, folded-leaf candles as the olearia, but as they are smaller, they are less spectacular.

By the boatlanding, the rocks at low tide look like pig iron. Above, the gray granite ledges are splashed on top with white lichens so tight and flat that I thought at first it was actually part of the rock itself. Other lichens are yellow and yellow-gold. A bit of grass and of the fine carpet plant already described grows on the landing rocks. At the top of these rocks there are larger grass clumps.

The specimens of the 26 kinds of plants on the island have to be preserved in several different ways for our museum preparators. Besides the color photography, water colors must be painted. Dried specimens are sewn up in cheesecloth—one of my jobs—or if too big, are nailed into crates. Fresh specimens, also sewn up in cheesecloth, are packed in cans of formalin, which will preserve their color. Trunks and bark and rocks are collected and are being labeled and packed



with utmost care, with numbered notes.

Mr. Newcombe listed the plants for me at breakfast. There are three trees or shrubs: olearia, groundsel, and veronica; three ferns; three grasses, two of which are tussocks; five sedges and rushes; nine small herbs like the carpet plant I have mentioned; and one white-flowered forget-me-not, plus two he didn't list. One of the herbs is called Captain Cook's scurvy grass, because he fed it to his ailing sailors in New Zealand.

Birds are the most interesting part of the collecting. As the Snares Islands are now a Reserve, permission was asked for taking what we would need. The Government

gave Bob Falla a list of all that might be taken. Though there is no limit on the bandit skuas or the muttonbirds, we are allowed twenty-six penguins, three terns, two tomtits, four silver gulls, and so on in order down the list. The work on the skins becomes an important matter, for nothing may be wasted. As I write, Bob Falla is doing a rather decayed silver gull, while Bob Murphy is working on a skua. In my tent just now I found exquisite study skins of Antarctic terns. I hope a skua will be exhibited with wings outspread upward, dropping into a penguin rookery, with another soaring above.

As I looked at the silver gulls and swallow-tailed terns, I asked why so many birds have red beaks and feet, like these two kinds.

"I came here to learn why," said Bob Murphy.

"And I don't know either," said Bob Falla.

Which remarks brought a story out of our jolly Mr. Baird. He told how two scientists were working over a table of specimens in a little English inn. They needed to con-



◀ "THIS VERONICA, one of the 26 kinds of plant life on our island, is called speedwell because of its brief blooming. The leaves are heavy and glossy, growing in geometric symmetry, and the flowers are white"

➤ "WE USUALLY STEPPED from one wobbly clump of tussock grass to another to avoid the deep dark mud between"



sult the *Encyclopaedia Britannica*, so asked the butler where it was. He replied:

"We lack one, gentlemen, but what is it you wish to know?"

As the men work, they sometimes look up for an instant, not really seeing me, of course, in their concentration. But I catch the chance and say: "Tea?"

"Tea," they always answer, as they go on working. Yet now, Bob Falla is taking time out to list the Snares birds for me, as I heat the brown and uninviting water that comes out of the drums. Tea or cocoa or fruit juice is needed in it. We start with three for tea, but more men straggle in, and toast and jam appear, while Bob Falla makes my list and Bob Murphy is oblivious to everything but his skua.

There are about the same number of birds as there are plants. Generally speaking, there are never as many varieties in cold as in hot climates. Yet the fauna and flora of the large Auckland Islands, a little farther south, are more varied than here on our mile-square island. We have typical sub-antarctic life, however, which fills the bill exactly for our museum exhibit.

The penguins are the Snares Crested, found nowhere else in the world. Their crest feathers, stiff and longish, grow out from yellow lines above their red eyes. Their backs and flippers are steel-blue, and their fronts are white. The young are brownish-gray, without crests. The heavy beaks are light brown-red. They are only about eighteen inches in height.

The muttonbirds, or shearwaters, flock in millions at dusk. The sky is filled with them, so that the highest-flying ones look like the clouds of gnats over my garden at home on a damp summer evening. They come from every point of the compass, flying roundabout, rarely, very rarely, bumping into each other. They come nearer and nearer until



throngs of them are close over our heads. Then they hurtle to their burrows. Everywhere at our feet are these beautiful gray petrels. One may stoop to pat their soft bodies, but when Roland picked one up, the bird bit furiously, drawing blood. How each bird knows its burrow in their honeycomb locations is one more unsolved mystery.

The next commonest birds in our cove are the silver gulls and Antarctic terns. They both fish, the silver gulls making quick strikes at their prey as they skim the water, while the terns dive in, wings folded. The gulls are twice the size of the terns, a little similar in color, with white bodies and gray wings. The gull has a bar of black across the ends of its wings, and the tern wears a black cap on its pretty head.

These birds nest among the rocks across the cove. "Come on," said Bob Falla to me, "we are rowing across to see them."

"I'll be waiting at the landing," I answered. I curled up on a rock with my back against a red water cask, enjoying rare warm sunshine. A sea lion came swimming up, sticking her head out at my feet. It is her landing place, not mine. She was far from being like the slug-gish things that sleep and cry on the open hillside. She stared at me, coming nearer and nearer. I stood it, then jumped, looking up

to see Bob Falla laugh as he always laughs at me for objecting to too close proximity to sea lions.

A few strokes took us across the cove in which "Alert" had spent short, dangerous hours. I squirmed up over broken, rough rocks. A tern's nest lay in a depression near a rock's edge. There was one egg in it. I crept to within six feet of the lovely mother quietly brooding. She was a little restless at our presence and flew off the nest, going back and forth with her mate as we came too near. Across a narrow bit of water, two parents fed a tern chick. It was too big to be downy like the young of so many sea birds. It had pretty speckled wings and a white body.

Silver gulls nested above in many places. Two performed a beautiful marriage dance, raising and lowering long wings and bowing as in a stately minuet. The male flew off and then returned, pleading. His wife was busy with her eggs and made it plain she had no time for love. His desire possessed him. His long raised wings trembled as he insisted she receive him. She, like all women, really wanted him. For a moment, the four exquisite wings and bodies blended. Then she thought better of herself, pecked him off, and returned sedately to brood over her eggs. Why need love stories, when Nature gives us silver gulls?

We rowed to the opening of the cove, with penguins porpoising all about us.

Of the outstanding birds, the skua is the fiercest. It lives on other birds and chicks. The whole island is covered with well-picked bones. Its only enemy is its own kind. It attacks us when we go too near the nests, diving down at our heads. We crouch or wave branches to avoid being hurt.

So when the men handed me a raw hen's egg and said movies were to be taken of me feeding it to a skua near its nest, I said:

"And if I lose my hand?"

"Oh, you won't lose more than two fingers. It is in the cause of science."

So there I was, egg in hand, told to crawl over the rocks and feed it to the skua, which we assumed to be the mother, with her two big chicks beside her—I, who had been attacked over and over, as had the men, by angry skuas fearing for their young.

It was, of course, a major experience, one of those that balance all the things one does not write much of. I crept forward, the egg on my outstretched fingers, the mother bird seeing it and opening her beak widely as if her mouth watered for the tender morsel she would not have to work for. Yet she backed away. I spoke in soothing tones. She waited. The camera was running. She was so unsure, yet so hungry. Her chicks need such a lot of food. I edged on. She waited. The men nodded at me, pleased. With a quick reach of her heavy bill, she grabbed the egg right off my fingertips.

So I have new sympathy for motion picture actors. The picture itself is all that counts. The men practically throw me to the sea lions so that they will rear and roar and make good pictures.

The camera trips are always fun. One day at the Penguins' Broadway, Bob Falla gently herded hundreds of penguins up, while I helped encourage hundreds down, with Bob Murphy grinding on. The birds scrambled so fast they fell over themselves. Those ahead, feeling they had reached safety, would

sit down and block the way for the frightened ones behind. Finally, I sat very still, and the men left. The birds coming up looked at me. The birds coming down looked at me. Then an old one from each group took courage, passed me slowly, and the traffic was resumed. Life at home without penguins looms drab and empty.

A few moments later, at the foot of the path, 28 skuas sat in a semi-circle around me, one walking up to within 10 feet. The wind ruffled the soft brown feathers of the one standing nearest me. The cliffs near by were marvelous in the sunshine. Their various shapes, the work of water, bird, and wind, look like animals, thrones, prows of ships with figureheads, the grotesques of Notre Dame in Paris, and a drunken sailor lying on his back.

The greatest ornithological experience here has been Bob Falla's discovery of nesting Cape pigeons, the farthest north record ever made. He landed on wild rocks where no one, it is thought, has ever been before.

Though Buller's albatross will nest here later, and Royals are to be seen offshore and over the island, with various petrels passing by, the birds I have told of are the outstanding sea birds of the Snares. There are three land birds, not counting many immigrants such as chaffinch, wax-eye, starling, song thrush, blackbird, English sparrow, hedge sparrow, redpoll, and goldfinch.

The little black tomtit is everywhere and is sometimes miscalled a robin. It is a fluffy, friendly, little bird, cocking its eye at one just the way a small puppy does. Its pretty body is short and plump, and its black bill is short. It hops on every limb, fearless, coming nearer when one talks to it—a truly charming bird like a little chickadee. Tomtits even come into the tents. Fernbirds hug the ground in goodly numbers. They are brown and furtive and mouselike. Both these birds eat insects off the muddy sea mammals that wallow everywhere, fly-covered and ugly. The snipe, sometimes erroneously called flightless, living for the most

part on the ground, are as particular to the island as are the tits and fernbirds but not as easy to see. There was great excitement on Thanksgiving Day when the men decided that the infinitesimal body of a snipe that was being made into a study skin, should be my Thanksgiving dinner. The word was broadcast via our radio telephone over all New Zealand. But I myself felt that a bowlful of rain water for a thorough washing was a still better celebration. "Has anybody had a bath?" "Why bring that up," make question and answer which are not welcome.

The few kinds of mammals on the island are compensated for by their bulk. Ton-and-a-half sea lions wallow everywhere, with tears running down their lazy eyes. These walrus tears are the only thing in this bleak spot to remind one of Alice's Wonderland. They are hideous beasts, like dark brown magots when lying flat on the ground. When they raise their heads and roar, with huge red mouths wide open, their great shaggy manes give them a majestic appearance. If roused, a sea lion could easily kill, but they are sluggish. Yet I noticed one or two of the men jump aside quickly from such beasts in the path. Fur seals are different, pugnacious and dangerous. I held a day-old baby seal in my arms, with the men watching the water to see that the mother did not approach. She would have killed me. High on the rocks one time, Hugh threw a clod at a fur seal. It growled and grunted furiously. I have never seen an angrier animal. It had just been in a fight and was all over deep, bloody wounds. Other seals were fighting near by. Two go after each other with their mouths. Their odor is unbearable, the worst wildlife odor I know. Returning from such a spot alone, I manage to avoid the animals by keeping a sharp lookout. If I slip flat in mud only once on a walk like that, I am lucky.



➤ "THE TWISTED TREES, their writhing trunks lying along the ground without the symmetry of trees, make no rhythm or design in all the forest"

Since the discovery of the four sea elephants, we see them constantly. They play in the current by the boatlanding, curling up head and tail in the semicircle they are famous for and then straightening out and floating and looking delighted with life. They seem to get just the pleasure out of playing in the water that we humans do. They are definitely curious about us, often raising their heads out of the cove to watch us and laugh at us.

Once when I was sitting among the penguins, I discovered that the biggest of the bull sea elephants lay asleep just below me. He was all over sores from fighting, and flies covered the sores. He gave deep sighs that shook his big belly. He kept his tail flippers crossed, resting in a pool, moving them a little in his restless sleep. He had chosen a kind of cradle in the rocks, lying with head lower than his tail flippers, dull and heavy. Finally half awakened by spray from the incoming tide, he humped his body, pushed with his hind flippers, jerked across the ledge, and stopped when the waves left him undis-

turbed, awkward, hideous. But as he slipped over the ledge into the sea, the beast became agile, interesting, and lively.

Our twelve days here are drawing to an end. Bob will be working to the last moment, wishing in spite of mud that he had twelve weeks instead of days in which to absorb the knowledge ready for him on this island. Enough has been done and collected so that the Snares exhibit can be created in New York.

Captain Black has come back. Bob said to him:

"Welcome to our Island," and he answered:

"You are welcome to your Island." "Alert" cannot come into the rough cove today but has found a lee for anchoring.

I said to Bob: "What news of the outside world did the Captain bring?"

"I didn't ask him," said Bob with emphasis. "There is too much natural history here to be bothered with anything else."

Bob Falla said he felt the same way.

How could they do their con-

centrated work if they felt any other way?

Everything is being packed. Nothing is being wasted as we waste so much at home. Here all materials receive their due regard. Mr. Stead is giving me the mutton-bird fried egg shovel that he ingeniously made from a top of a tin, some wire, and a stick of wood. Bob Falla gave me the toaster made of a bit of bent wire on a long wire handle, crude but most efficient. The mess tent is dingy with smoke and dirt, but the food supplies are still ample.

As I sloshed through the muddy path just now for the last time, the penguins climbing up in single file scampered, and I said out loud:

"You'll have it all back soon, my darlings," and my mind shot ahead to the island as it will be presently, with not a person on it, a dirge for us and a paean for the birds and beasts. I sat on the rocks watching till rain came on.

Walk, walk, hop. Walk a way. Hop. Stand. Look around. Kiss the lady. Peck at that half-grown bird and chase him. Then dive into the







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waves where you are in truth in your element. The penguins shake their tails and tremble their flippers and scratch. They swim in their rock pool and cleanse themselves as I hope that I shall be doing tomorrow. We will take our beating on "Alert" first. I am to continue on the next cruise. They had planned to put me aboard the luxurious Government yacht "Matai." But now the Captain, who did not want a woman along, says: "Forget 'Matai' and stick with us, Mrs. Murphy." I will, with thanks and joy. I hear that he has even brought sheets for me. Such pampering! I am tired but very happy. I have learned far more than sub-antarctic natural history.

On the last night, as I lay in my narrow cot, I had a sudden horror over the wildness of this place. The twisted trees, their writhing trunks lying along the ground without the dignity of trees, make no rhythm or design in all the forest. Instead, they make a scrawling dissonance

like a Dante's or a Doré's Hell. One could imagine them moving to engulf one, with filthy sea lions crawling on their bellies, adding to the horror. And over all, a loneliness of gales and desolation and adjustment to desolation. It would drive one mad to be left alone in such a place, in spite of respite of the friendly little penguins, the soft beauty of the terns and gulls, the majestic inspiration of pounding waves on fantastic rocks below huge cliffs. The Maoris have a legend of a maiden condemned to exile alone on such an island. The night crying of the sea birds—to her, voices of the spirits—drove her insane.

The sub-antarctic is for a different race of men. It is breathless. It is magnificent. But it has twisted me in two and pulled the parts through a needle's eye. The men I have spoken to about it say it is always so, that they feel it, too.

Tomorrow there will be flowers in the gardens of the tiny town of Oban on Stewart Island.



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the text itself employs the common names of the creatures described. It thus runs smoothly, and the reader's attention is not diverted from the queer habits, the life span and dimensions, the uses to which each kind is put, the many other details that make this book rich in entertainment and useful as a reference.

LORUS J. and MARGERY J. MILNE.

## ISLAND LIFE IN LAKE MICHIGAN

- - - by Robert T. Hatt, Josselyn Van Tyne, Laurence Stuart, Clifford H. Pope, and Arnold Grobman

Cranbrook Institute of Science Bulletin No. 27, \$4.00  
179 pp., 43 illusts., 1 map, 15 tables

**M**AN probably has been fascinated by islands since he first began to devise means of getting himself to such isolated bodies of land. Naturalists have found islands to be of particular interest not only because of the strange animals found on some but because of the light that studies of insular faunas have thrown on evolutionary processes. Darwin's studies in the Galápagos nearly a century ago helped him lay the foundation for his stimulating theories. These in turn were implemented by those of Wallace, who had studied distributions in the Malay Archipelago. Modern notions concerning the origin of species are, in part, derived from the increasingly adequate researches dealing with islands and the peculiarities of their faunas.

It was not a "shot in the dark," therefore, when the Cranbrook Institute of Science, collaborating with the University of Michigan, undertook investigations of the islands lying off the western shore of the Lower Peninsula of Michigan. The distributions as well as the habitats of the amphibians, reptiles, birds, and mammals living on these islands were studied intensively over an eight-year period, and the resulting data are summarized and analyzed in this report.

Among the more important topics discussed are the means used by the various animals in gaining access to the islands, the actions of predators and pests, the effect of changes wrought by man, and the varying water level.

The conclusions reached are neither new nor startling. Nevertheless, the book reflects the meticulous efforts of competent investigators who have been willing to make a far more extensive analysis of fresh-water island faunas than is given in any previously published work. The book is written in a simple, matter-of-fact style, with few embellishments beyond some excellent photographs and an attrac-

# Natural History CRYPTOMAZE

RIVERS By EDWARD DEMBITZ

**Part I.** In this test you are given a set of definitions, each with a set of blank spaces, and a diagram to be filled in. Each definition is a clue to a word whose letters you are to insert in the blank spaces preceding the definition.

<u>14</u>	<u>22</u>	<u>17</u>	<u>10</u>	<u>4</u>	<u>4</u>	<u>6</u>	<i>A wind named after a tribe of Indians of Washington and Oregon</i>	
<u>14</u>	<u>9</u>	<u>13</u>	<u>18</u>	<u>3</u>	<u>18</u>	<u>17</u>	<u>14</u>	<i>The latest era of geological time</i>
		<u>22</u>	<u>18</u>	<u>18</u>	<u>5</u>	<u>4</u>	<u>9</u>	<i>An Old World bird having a slender curved bill</i>
		<u>8</u>	<u>17</u>	<u>21</u>	<u>17</u>	<u>25</u>	<u>23</u>	<i>Brightest star in the heavens</i>
<u>20</u>	<u>17</u>	<u>16</u>	<u>2</u>	<u>7</u>	<u>21</u>	<u>8</u>		<i>American naturalist specializing in reptiles; died 1942</i>
	<u>7</u>	<u>1</u>	<u>22</u>	<u>17</u>	<u>20</u>	<u>8</u>		<i>Sap-sucking insects exploited by pastoral ants</i>
	<u>1</u>	<u>15</u>	<u>6</u>	<u>17</u>	<u>13</u>	<u>19</u>		<i>An extinct species of man</i>
		<u>16</u>	<u>18</u>	<u>5</u>	<u>7</u>	<u>3</u>		<i>Crystalline mineral and gem stone; 8 on Mohs' hardness scale</i>
<u>24</u>	<u>12</u>	<u>15</u>	<u>7</u>	<u>23</u>	<u>16</u>	<u>15</u>	<u>20</u>	<i>American oriental scholar and archaeologist; author of History of Egypt; died 1935</i>
				<u>11</u>	<u>12</u>	<u>25</u>	<u>24</u>	<i>Any thick wormlike larva, as of a beetle</i>
<u>11</u>	<u>17</u>	<u>10</u>	<u>23</u>	<u>15</u>	<u>10</u>	<u>19</u>		<i>Aromatic root, valued in China as a medicine</i>
			<u>2</u>	<u>25</u>	<u>17</u>	<u>12</u>		<i>Alaskan glacier, named after American naturalist and explorer</i>

**Part II.** When you have filled in all the letters above, transfer them to the proper numbers in the boxes in the diagram below.

When the diagram is completed, you will have a word maze containing the names of at least TWENTY RIVERS. To find a river, begin with a letter and move from space to adjoining space in any direction, including diagonally, until its name is spelled out.

Copyright 1948  
By Edward Dembitz

	1	2	3	4	5
	6	7	8	9	10
	11	12	13	14	15
	16	17	18	19	20
	21	22	23	24	25

**THREE PRIZES.** The three contestants submitting the largest number of rivers fitting this puzzle will each receive a copy of *The Earth's Grandest Rivers*, by Ferdinand C. Lane, an outstanding book soon to be published by Doubleday and Company.

*The Gazetteer in Webster's New International Dictionary (1948)* will determine the eligibility of rivers. One error will disqualify a contestant. In case of ties, duplicate prizes will be awarded.

Entries must be received on or before December 29, 1948.

Winners and their scores will be published in *NATURAL HISTORY Magazine* for February, 1949.

The contest is open to everyone except employees of the American Museum and Doubleday and Company.

tive binding. Students of natural history will find it worth their while, whether they are interested in the animals themselves or in the principles discussed.

C. M. BOGERT.

## CLIMATIC ACCIDENTS IN LANDSCAPE MAKING

----- by C. A. Cotton

John Wiley & Sons, \$7.00  
344 pp., 149 figs., 58 plates

THE geological doctrine of uniformitarianism, which is the theory that erosion and deposition are taking place today at the same rate that they have in the past, has tended to create a misleading impression that all geologic processes proceed at a very low tempo. Geologists and laymen alike come to regard changes in the earth's topography as the sum of an infinite number of very minute additions or subtractions. The casual addition of a few more million years to the age of the earth with each new method of calculation tends to emphasize the slow rate of change, from the geologist's point

of vantage on the reviewing stand. Hence, we have perhaps erred by going too far, by creating the impression that all relief forms are the result of slow processes. It was somewhat of a shock to discover that a very minor volcano could grow 1000 feet high in a few months, or that 300 feet of lava could pile up in successive flows in five years.

Those of us who live in regions of temperate climate are accustomed to seeing the soil protected from rapid erosion, so we are less likely to appreciate the importance of special processes where extremes of climate, dryness or cold, accelerate the topographic changes wrought by degradational forces. Professor Cotton's second book on geomorphology deals in detail with abnormal conditions of erosion and their result. Though a textbook in its treatment, it is, nonetheless, an interesting reference work for travelers who really wish to understand the derivation of the land forms they will encounter in trips to desert country. The peculiar phenomena of glaciated mountainous regions, the hanging valleys, the *roches moutonnées*, the cirques, and the glacier-formed lakes are also explained. Desert and mountain

scenery is illustrated so that the special effects will be recognized when they are next encountered.

The well over 100 photographs and the sketches in the text illustrate the features described. The casual reader will, as a matter of fact, find the book more interesting if he starts with the pictures, recognizes in them some feature about which he has wondered in his own travels, and then applies himself to the section of well-indexed reading matter explaining the derivation of the particular land form. Only a student would attempt to read *Climatic Accidents* from cover to cover, but anyone will be interested in reading up on familiar land forms, jumping from one section to another. Just as the most appreciative section of a traveler's lecture audience is largely those people who already know a place, so will the browser in this book like best the explanations of the mesas, the barcanes, and the yardangs he has seen on his own travels. Professor Cotton has done an excellent and authoritative job with this text, and its appeal should not be limited to a group of students of geomorphology.

F. H. POUCH.

## LETTERS

Continued from page 334

*Journal of Parasitology* (vol. 28, p. 235) that six of nine raccoons from Texas that were examined in the month of December harbored this worm. Trappers of the area say that ulcers, presumably for escape of the embryos, are common on the feet of raccoons caught in January and February. But human cases rarely or never occur in the area. Chandler mentions only one doubtful human case.

Unquestionably this parasite of raccoons should be placed in the genus *Dracunculus*, but its specific identity is not at all certain. Chandler thinks that it probably represents a distinct species and accepts tentatively the name *D. insignis* (Leidy, 1858). However, Chitwood, who has reported Guinea worms from raccoons and mink in Ontario, New York, and Nebraska believes the American species is *Dracunculus medinensis* of the Old World. Benbrook found this American version of the "Fiery Serpent" in the dog, fox, and mink in Iowa.

Obviously the parasite is widely distributed geographically in this country and is common among raccoons in some areas and at certain times of the year. There our knowledge stops.

Is the American Guinea worm the Old World "Fiery Serpent"? If distinct, is it

capable of producing disease in man? Does it seriously affect the health of wild animals? Scientific inquiry can answer these questions, but the opportunity to pursue such investigations is so limited that we may look forward to many years of "blissful" ignorance before reasonably complete answers are available.

PAUL D. HARWOOD.

Ashland, O.

Dr. Harwood's information is correct. But because people in the United States have sanitary drinking habits, there is practically no chance of a person becoming infected with this parasite, even if it is *D. medinensis*, which is not certain.—ED.

• • •

SIRS:

I am English and have the habit of collecting papers and magazines for a sanatorium at Colchester. In this way I came to have one of your issues of *NATURAL HISTORY*. It was received with such interest by all who saw it that I wonder if anyone who receives the Magazine regularly would let me have the copies to pass on, or sponsor a subscription which would be gratefully received by the patients in this hospital. In any case, let me thank you for bringing me in contact with such a lovely and interesting periodical.

Mrs. W. BRITAIN,  
("An ordinary housewife").

London, England

### Rare African Butterflies

One of the most striking and colorful collections of butterflies in history has been received at the American Museum

of Natural History, it was recently announced by Dr. Mont A. Cazier, Chairman of the Museum's Department of Insects and Spiders. The collection, which numbers some 2000 butterflies from the remote Nyasaland region of Africa, was presented to the Museum last week by Mr. Arthur S. Vernay, naturalist-explorer and Trustee of the Museum. At least 30 species new to the Museum's collections are represented in the extensive collection, and further study by Museum entomologists will probably reveal a number of entirely new subspecies.

The butterflies were obtained along with significant collections of mammals and plants by Mr. Vernay while he was leading the Vernay-Nyasaland Expedition, one of the Museum's most recent African expeditions. Mr. Vernay collected 1500 butterfly specimens and in addition presented the Museum with 480 perfect specimens already identified by European experts. This collection was acquired from Mr. Rodney C. Wood of Nyasaland.

Close to 100 of the most interesting and beautiful of the Nyasaland butterflies are on special display in the American Museum's Seventy-seventh Street Foyer. Largest and most spectacular of the butterflies on display are the genera *Papilio* and *Charaxes*. The genus *Charaxes* does not occur in the New World but is found in most parts of the tropic East.

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# LETTERS

## Thread-waisted Wasp

SIRS:

The performance of an insect that my sister and I witnessed might be of some interest. We were sitting on a sandy bank of a river when a black-and-red insect like a wasp, about an inch long and very thin, came up beside me carrying a grub or caterpillar at least an inch and three-quarters long and as thick as a pencil. The insect carried it under its body in the way the lumber trucks pick up loads of planks (perhaps that is where the inventor got his idea). The wasp also seemed to be a combination pile driver, sand blaster, and excavator. It dug a deep, slim hole in no time at all, scratching it out at first and then, when the hole got too deep for that, carrying large quantities of sand out in its mouth and depositing it six inches away.

It dragged the grub into the hole end-first and after a few minutes came out and started filling the hole. At first, it took the sand down in its mouth, and this is where the pile-driving performance came in. After every few loads, it stood on its head and banged the sand down with the top of its rather large, flat head. This went on until the hole was level. Then it went off six inches and sprayed the sand with perfect aim on top of the hole. It finished the job with a few bits of gravel and tiny sticks, and flew away.

We take *NATURAL HISTORY Magazine* and would like to know if this was done for food storage or whether the wasp laid its eggs in the grub.

MRS. J. R. ELLIS.

Glendale, Calif.

The following comments are offered by Mr. Herbert F. Schwarz of the American Museum's Department of Insects and Spiders:

Such phrases in Mrs. Ellis's account as "a black-and-red insect like a wasp, about an inch long and very thin," coupled with the fact that the insect was carrying a caterpillar and deposited its prey in a tunnel it had dug in sandy soil, suggest that it was one of the thread-waisted wasps of the genus *Sphex*. The act that Mrs. Ellis and her sister witnessed is performed in the interest not of the industrious adult wasp herself but of her future offspring. After the tunnel has been drilled and the prey deposited, the mother wasp lays an egg upon her helpless victim, which is paralyzed by her sting, and then entombs both victim and egg. The wasp larva that emerges from the egg proceeds to devour the ample banquet, consisting sometimes of more than one caterpillar. It attains its full growth, pupates *in situ*, and finally emerges a winged adult to glimpse the world of sunshine after a childhood and adolescence spent in the darkness of the earth.



▲ FEEDING JAY: An intimate study of a bird that does much to liven the autumn woods and may be seen in midwinter in any part of its range. Photograph by F. E. BRICKEL

Mrs. Ellis speaks of the insect as forcing "the sand down with the top of its rather large, flat head" and also alludes to the insect as a "pile driver." More remarkable still is the fact that certain members of the genus *Sphex* have been observed actually holding a small pebble or a bit of wood between the mandibles and using it to pound the filled-in orifice of the tunnel until the spot is "as hard and firm as the surrounding surface," to use the phraseology of the Peckhams, who were among the first to observe this phenomenon. Here is a true use of a tool, the employment of something extraneous to aid in achieving a given end.

One student of insect behavior has pronounced the act "highly individualistic," but the mounting number of similar instances that have been observed would lead one to believe that this is one of the steps in a behavior sequence shared by at least seven species of *Sphex*. Twenty-five years ago, William Morton Wheeler, in his *Social Life Among the Insects*, noted that no less than nine investigators had observed this phenomenon, and a further observation was con-

tributed to *Science* the following year by George C. Wheeler and Esther Hall Wheeler. In 1932, Hicks supplied two additional instances in articles contributed to *The Canadian Entomologist*.

Since this interesting employment of a tool has been observed repeatedly, there is encouragement for those who wish to share the thrill of witnessing it themselves.

## Spined Snake

SIRS:

About ten years ago, I was told that in a certain locality in the mountains, about twenty miles west of my home, there were snakes that looked like rattlesnakes but had a sharp spine on the end of the tail instead of a rattle. One of the spines was given me by a Forest Warden. As I have collected nineteen species and subspecies of our local snakes and have never gotten one equipped with a spine, I wanted to visit the above-mentioned place in the hope of catching a new species. Last summer I had the pleasure of spending a day there and was fortunate in finding a fine specimen of a hognose snake (*Heterodon*) about three feet long. Its tail was tipped with a sharp spine



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one-half inch long and quite different from the blunt tails of the many specimens of *H. contortrix* I have examined.

I wanted to send this snake to C. M. Bogert, of your scientific staff, for identification, but unfortunately the snake forced its way like a mole through a burlap bag and escaped. I have one consolation, namely, that several of our party will testify to the fact that the snake was in perfect condition and did have a spine, and it is probably the snake that looked like a rattlesnake.

D. P. LE FEVRE.

Cumberland, Md.

C. M. Bogert, of the American Museum's Department of Amphibians and Reptiles, states:

It would not be normal for even a large hog-nosed snake to have a spine one-half inch long. Exceptionally long spines at the end of the tail rarely develop as the result of an injury but might be expected to occur as a result of rare embryological abnormalities or even from unusual genetic sources.

The fer-de-lance, the bushmaster, and a few other snakes have spines on the end of the tail that exceed in length and prominence those of the average snake, although they are not put to any special use, as far as is known. On the other hand, some burrowers, like the blind snakes of the tropics, have very sharp but short spines that appear to be used as a means of anchoring the hind part of the body.

The mud snake, or "hoop snake" (*Farancia*), which, needless to say, does not perform like a hoop, has a stout, sharp spine with a definite use. Mr. George P. Meade of Louisiana reports that he has observed captive mud snakes feeding on the aquatic salamander known as the "congo eel," a creature nearly a yard long and quite capable of biting effectively in defense. When seized by a congo eel, mud snakes were able to jab at the prospective prey with the tail, inflicting deep scratches that resulted in the "eel's" releasing its grip. When handled, mud snakes frequently maneuver the tail so as to bring the spine into play, pushing it into the skin of the handler, with harmless if somewhat startling effects. The supposedly dangerous nature of the spine, or "horn," has resulted in such local names as "stinging snake" and "horn snake," neither of which is very appropriate. Still they are preferable to "hoop snake" and its erroneous implications.

#### Beetle Hunt

A 21,000-mile search in the United States and Canada has yielded the largest single collection of Tiger Beetles in history for the American Museum of Natural History. More than 15,000 individual specimens, including 6 entirely new subspecies hitherto unrecognized by scientists, were collected by Dr. Mont A. Cazier, Chairman of the Museum's De-

partment of Insects and Spiders, on his five-month trip.

The Tiger Beetle, *Cicindela*, is important to science because it survives and thrives in every known region in the world, adapting itself in remarkable ways to varied environmental conditions. In color alone, the same species ranges from almost black in the eastern section of the United States, to bright red in Texas and the Midwest, to bright green on the Pacific coast. Dr. Cazier cites this wide variation as an indication of the rapid and basic genetic changes of which the insect is capable.

Most of the Tiger Beetles known in the New York area can be recognized by patterns of stripes which resemble the markings of tigers. It is from these stripes and from its voracious habits that the Tiger Beetle gets its colorful name. It is one of the most pugnacious of the carnivorous insects. It feeds on other animals exclusively and does not feed on any form of plant life.

Two other collecting projects carried out during the summer for the Department yielded approximately 5000 specimens of *Cicindela*, which will furnish additional data for continuing studies and publications on this group of insects.

Dr. Cazier stated that this collection, added to the Museum's previous specimens of Tiger Beetles, will provide the Museum with the world's largest and most comprehensive collection of American *Cicindela*. The Museum's collection now includes a total of more than 70,000 classified specimens.

#### Uncut Minerals and Jewelry

A novel exhibit has been placed on display at the American Museum of Natural History highlighting a new trend toward the utilization of a host of natural minerals such as beryl, white topaz, and quartz in artistic jewelry.

The exhibit is one of a series of displays emphasizing the beauty of form of uncut crystals and showing that their natural symmetry is frequently more exciting than the stereotyped facets placed upon them by the unimaginative lapidary. The exhibit features jewelry designs by Miss Pearl S. Shecter, Art Director of Elizabeth Irwin High School, "The Little Red School House." Miss Shecter has been a recognized designer of metal forms since 1937 and has studied with some of the world's leading metal designers and silversmiths. The 21 new designs incorporated in the temporary exhibit are all being shown for the first time.

Striking and colorful plastic forms employed in the exhibit have been designed by Gwen Davies, modern abstract painter, while the entire exhibit and the execution of Miss Shecter's designs have been done by Miss Agnes Schleicher.

The exhibit, which is on display in the Morgan Memorial Hall of Minerals and Gems, will remain on display through January.

# NATURAL HISTORY

The Magazine of the American Museum of Natural History

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VOLUME LVIII—No. 1

JANUARY, 1949

Bird-of-Paradise Flower.....Cover Design  
*From a Kodachrome by W. H. Hodge*

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## THE COVER THIS MONTH

The Bird-of-Paradise Flower (*Strelitzia reginae*) is the most colorful of the four species of this South American genus and perhaps of all the exotic Musaceae, the family containing the bananas and heliconias. (Examples of the latter two have already appeared on the cover of NATURAL HISTORY: September, 1946, and March, 1941.) Three bright orange sepals and three deep blue petals (one reduced) arise from the curious green, boat-shaped bract. One or two flowers are usually open at a time; and as they fade they are replaced by new ones from buds inside the bract.

This is one of the relatively few plants (along with bananas and heliconias) whose pollination is effected by birds. In its homeland, honey suckers are the chief pollinators. Attracted by the nectar and by the small insects likewise lured, the birds land on a special blue "landing platform," and their weight causes the petals to open, allowing pollen to be dusted on feet and breast.

*Strelitzia reginae* (literally "Strelitzia of the Queen") was named in honor of the wife of England's King George III, a queenly patron of botany, whose maiden name was Mechlinburgh-Strelitz.

W. H. HODGE.

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Atherlie E. Karp, *Editorial Assistant*.

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## WILD ANIMALS OF THE WORLD

Animal Portraits by Mary Baker,  
Text by William Bridges,  
Introduction by Roy Chapman  
Andrews

Garden City Publishing Company, Inc.,  
\$4.95

272 pp., 252 illstrs.

THERE is a very real desire springing up in the inquiring mind of this modern age for informative facts about wildlife. No longer is it just idle curiosity that prompts the layman to invest in a work on natural history. The past two catastrophic world wars and the subsequent periods of grave unrest have dampened human ardor for personal gain and glory. In search of security, man's emotional sanity is now instinctively drawing him back to the bosom of nature and the cradle that nursed him. The time is now ripe to fortify literature and stimulate the public thirst for natural history with a popular synthesizing of accurate facts portrayed by intellectual experts in this field.

With simple unassuming directness *Wild Animals of the World* brings to the very fireside living representatives of nature from many faraway fields. Not in terms of hard, cold facts but as living creatures bold and courageous in a world where they have been hunted and persecuted since civilized man started on his plunder of this planet.

With a singleness of purpose Mary Baker has succeeded in catching the subtle charm of the wild things in her portraits that give them life, beauty, and character. Obviously no attempt has been made here to represent all the living mammals. Science recognizes approximately 15,000 different kinds, and a review of the entire world fauna would defeat the purpose of this book. There are 252 portraits of animals (100 of them in color), representing two years of devoted application by Mary Baker.

William Bridges is responsible for the animal biographies; they are not and

were not intended to be complete in a technical sense, and therein lies one of the virtues of this work. *Wild Animals of the World* virtually is a cross section of mammalian life bringing out the obvious, the strange, and the curious animals and depicting their special and peculiar characteristics.

Open the book at random, and the page will speak for itself. It won't be necessary to explain that both Mary Lee Baker, the artist, and William Bridges, the explorer, are well equipped. Both are enabled by background to portray vividly and accurately the spirit and character of wildlife.

GEORGE G. GOODWIN.

## THE HEATHENS: Primitive Man and His Religions

----- by William Howells

Doubleday & Company, Inc., \$3.75

306 pp., 16 illstrs.

HEATHENS, originally, were the dwellers on the heath outside and away from the village, the town, or the monastery. They were uncouth in manners and backward in the arts, and, still unconverted, they practiced the ancient pre-Christian rites. Of these connotations of the word only the religious one has survived to this day in a somewhat more restricted form. In its modern usage, a heathen refers to one who follows religious beliefs distinct from the great religious systems such as Christianity, Judaism, and Mohammedanism. His manners, however, may be polished and his arts displayed with reverence on 57th Street.

The heathens of this world run into many millions, and if the most profound convictions of so large a proportion of mankind deserve attention, then a study of their religious behavior and beliefs is of considerable importance. But the religious convictions of heathendom make a more poignant appeal to us than the mere number of their professors. They reveal the basically human response to the mysteries of the unknown and the incomprehensible, the substratum from which the most refined religious expressions of our own civilization have emerged.

The response of primitive man or heathen to the world around him is fundamentally one of fear and awe, and his efforts to propitiate or control the forces he envisages take a variety of forms, all of them of intense fascination. Dr. Howells has covered virtually every category of heathen religious behavior recognized by students of the subject, and he has done so with skill and understanding. As in *Mankind So Far*, he dissects a difficult subject with apparent ease and always gracefully. No one could ask for a better introduction to an absorbing subject.

HARRY L. SHAPIRO.

## BRITISH BIRDS

----- by Wilfred Willett

Illustrated by Roland Green

Adam and Charles Black, London  
The Macmillan Co., N. Y., \$2.50

196 pp., 16 colored plates, 44 drawings

THIS book is a popular account of the better known or commoner British birds. It is intended for visitors to the British Isles or for residents beginning bird study as a hobby. The appearance, seasonal occurrence, food, and nesting habits of some 200 species are described in more or less detail. The author is familiar with his subject, and very few errors are evident. Some omissions are puzzling. The black redstart, for example, is said to be a winter visitant, and there is no mention of its recent remarkable appearance in British cities as a nesting bird among bomb ruins. The absence of scientific names is perhaps not a disadvantage in a work of this nature, but it is puzzling to find a bird called by one name in the text and another on a plate, as is true of the "French partridge." Mr. Willett writes in an informal and at times bucolic vein, with keen appreciation of



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KANA, PRINCE OF DARKEST AFRICA  
PAULI AND HIS HAWAIIAN FEAST

# **The BOOK SHOP**

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the English countryside and its human as well as avian inhabitants.

The paintings and drawings by Roland Green are an important feature of this book. His recognized ability to capture the character of a bird in a simple black-and-white sketch is often evident here. The colored plates usually depict a family group of birds; one is an engaging study of assorted downy young and nestlings. The low price of this copiously-illustrated volume is presumably a result of its manufacture abroad.

*British Birds* will be of service to anyone desiring a nontechnical and yet tolerably complete survey of British bird life.

DEAN AMADON.

## ALONG YOSEMITE TRAILS

----- by Josef Muench

Hastings House, \$2.75

101 pp., 121 illu.

SCARCELY 26 years after the discovery of Yosemite by the Walker party in 1833, a photograph was taken within the Valley. Sketches had been made four years earlier by Thomas Ayres in 1854. Since then the grandeur of this stupendous region of glacier-carved valleys have been extolled in pictures for a period of time that now approaches a century. With the possible exception of the Grand Canyon, none of our National Parks has been so frequently described and depicted.

Consequently, it would be presumptuous for any ordinary photographer to prepare an entire album of Yosemite photographs. But readers of *NATURAL HISTORY Magazine*, *Arizona Highways*, and countless other publications know that Josef Muench is no ordinary photographer. His pictures of the West are unsurpassed, and in this volume the reader is privileged to see 121 of the finest ever made within the boundaries of Yosemite National Park.

As Joyce Rockwood Muench points out in a brief introduction, the Valley itself is "a scenic gem of the first magnitude" contained within an area of eight square miles. Yet few realize that the 1189 square miles included in the preserve are "far from being a buffer region to keep intact the core of the park. It is an empire in itself, repeating with a thousand variations, the same formations and grandeur of the smaller part." Josef Muench has singled out the spectacular and the beautiful as only he could do it.

The photographer of 1859 would stare agape at the fine gravure reproductions depicting not only the famous falls and

towering cliffs but also the lakes, big trees, camps, flowers, pack animals, deer, and bear—and the reader of 1949 will stare with admiration at the results obtained by a top-notch artist with a camera.

C. M. BOGERT.

## TROPICAL BIRDS FROM PLATES BY JOHN GOULD

With an Introduction and Notes on the Plates by Sacheverell Sitwell

B. T. Batsford Ltd.: London,  
New York, Toronto, \$2.00

12 pp., 16 color plates

JOHN GOULD was the nearest equivalent to Audubon in Great Britain. Between 1830 and 1880, he completed 41 large folio volumes with no fewer than 2999 hand-colored plates. This incredible output was the result of collaboration between Gould, the ornithologist, and a group of artists including Mrs. Gould, Edward Lear, H. C. Richter, and William Hart.

One cannot argue about tastes, but there are many who prefer the simplicity of the Gould plates to the elaborate body postures of Audubon's birds. Gould plates have now become collectors' items, and it will be appreciated by many lovers of bird art that 16 of the most colorful bird plates are now available here in an excellent offset reprint. The descriptive text does not measure up to the beauty of the plates. In addition to numerous errors, it is full of cheaply "clever" characterizations of birds, such as this one about the Spotted Kingfisher: "Something of an ascetic, like the gurus or holymen of the caverns in the mountains, and this Kinghunter, as it should be called, has some of the appearance and imputed wisdom of the Hindu sage." The beautiful reproduction of the Gould plates more than makes up for the inadequate text.

E. MAYR.

## COPSFORD

----- by Walter J. C. Murray

George Allen and Unwin Limited,  
Ruskin House, London

The Macmillan Co., New York, \$3.50

164 pp., 23 illu.

*COPSFORD* might well be classed as a eulogy on the struggle between man and the infringing forces of nature. It is the autobiographical story of a man who left a dingy flat on a back street in London for the solitude of a desolate, half-ruined cottage in rural England, which had neither road nor footpath connecting it with habitation. From the very first, the author is disturbed by the oppressive loneliness of the place, which numbs his will and saps his strength. He wages war against a legion of wild crea-

tures that contest his legal right to live at Copsford and ekes out a meager living by harvesting wild herbs. Although eventually beaten at the post, he carries on a winning battle for a year among the wild creatures and plants around him. He is there for a purpose, but the reader is kept in intriguing suspense until the fifth chapter before he is given any inkling of the type of work this city-bred man is doing at Copsford. The reader is somewhat reminded of the Pied Piper, White's Selberne, and perhaps Dickens's *Christmas Carol*.

This strange and yet amusing story reveals the author's intimate experiences with the wildlife in a countryside of unspoiled woodlands, meadows, and brooks. He seems to have lived and felt with the plants and animals he describes for us. Light and darkness, summer and winter—vital things to nature's children—become part of his life as well as theirs.

Walter J. C. Murray is one of the small band of naturalists who can write. *Copsford* is a pleasure to read for itself alone, as the following quotation will show. "What else is there so tragic as the loss of a life-form that can never reappear? I know it has happened hundreds, more probably thousands of times in the past; creatures have, as it were, taken the wrong turning to find themselves in a blind alley from where there is no retreat, only extinction . . . but it comes as something of a shock that the Large Copper Butterfly on the wing within living memory is as extinct as those monsters of the Cretaceous Age."

GEORGE G. GOODWIN.

## ATLANTIC REEF CORALS

----- by F. G. Walton Smith

Univ. of Miami Press, Distributed by  
Farrar and Rinehart, \$3.75

112 pp., 41 plates

THIS little handbook fills a long-felt want for a convenient means of identifying the reef corals from the tropical waters of the western Atlantic. It is indeed a sad commentary on the present state of invertebrate taxonomy in this country that until the publication of Dr. Smith's earlier key in 1943, anyone wishing to identify one of these important and conspicuous organisms had to consult a specialist or search through a large number of incomplete and highly technical reports, usually to be found only in very large libraries. The key and descriptions in the *Atlantic Reef Corals* are accurate, written in nontechnical lan-

Continued on page 48

## SEA AND LAND SHELLS

If you are a buyer of this class of invertebrates send for my *Conchological Chatter* which appears monthly listing choice Mollusca from every part of the world. Collections for sale of any size up to 5000 species. Also books on Mollusca.

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▲ A STALWART NATIVE of the Society Islands, where the ceremony was held

ONE of the strangest ceremonies of the South Seas, still performed on many islands of the far South Pacific, particularly in the eastern Polynesian archipelagoes, is the mysterious ritual of fire walking, in which barefooted natives promenade slowly over a long square pit of rocks heated to a glowing intensity. The participants believe that by this ritual they undergo purification.

For the benefit of those who are skeptical as to the authenticity of the rite, the natives offer themselves for examination before and after

walking over the fiery furnace. They do not coat the soles of their feet with a secret salve, nonconductive to heat.

I first witnessed and took part in a fire-walking ceremony upon my return to Tevaitoa, Raiatea, a small island of the Leeward Group in the Society Islands of the far South Pacific. I had come from a long voyage across the islands and atolls of the Marquesas and Paumotu groups, and my Polynesian host and friend, Ari, a native of Raiatea, met me at the small jetty and conveyed the news. His handsome countenance was twitching with suppressed excitement, and he talked with great enthusiasm. The *Umuti* (Fire Walk) was a wonderful thing, indeed!

Chief Terii-Pao, the famous fire walker of Raiatea, had aroused himself from his happy indolence and had gone with his assistants to the sacred valley to prepare for the elaborate ceremony. His assistants, under his watchful eyes, had constructed a huge oven and felled trees for fuel. Now the oven, heaped high with rocks, was ready to be ignited at dawn of the following morning. Terii-Pao and his priests (*tahuas*) had finished their walking and chanting around the oven (*Umu*) and had gone into seclusion to confer with the spirits of the deceased (*tupapaus*) and the Goddesses of the Sky, who would permit them to walk upon the fiery furnace.

Large numbers of natives had

paddled in their outrigger canoes and steered their sailing canoes from the adjoining islands of Bora-Bora, Tahaa, Huaheine, and Maupiti to witness the ritual. Many of the canoes were beached upon the strand, loaded to the gunwales with fruits, vegetables, and fishes for the great feast that would follow the fire walking. Skilled dancers from as far away as Tahiti and Moorea had come to entertain.

I sat down with Ari on the veranda of his home facing the blue sunlit lagoon and coral barrier-reefs, foamy with the broken combbers of the South Pacific, and he gave me the historical significance of this ancient rite.

Fire walking, according to legend, was the outgrowth of famine. During periods of drought or when hurricanes destroyed the natural foods of the islanders (wild plantains, breadfruit, and coconuts), it was necessary to turn to a food ordinarily scorned by the natives—a tuber contemptuously consigned to the wild pigs of the valleys, who uprooted and subsisted upon it. This was the root of the wild giant arum plant (*ape*), a species of taro that grew rampant in the valleys. The leaves of the ape grow to great heights and are veritable elephant's ears in shape. Its roots, shaped like large war clubs, grow from two to three feet in length and weigh about twenty or thirty pounds each. In Hawaii and in many islands of the South Pacific, a smaller species of taro, mashed and fermented

# FIRE WALKERS of

A man who actually participated in this celebrated rite offers his explanation of how it is possible to walk across a bed of hot rocks without injury

By WILMON MENARD

All photographs by the author unless otherwise credited

slightly, is known as the popular poi.

Thus the story has it that when starvation threatened, the villagers went to the valleys for the scorned ape roots. Giant arum is one of the most difficult island foods to render digestible. To be cooked thoroughly an intense fire must be prepared, and the tuber must be allowed to bake for many hours. This may possibly account for the lack of interest in this food during periods of plenty, as the islanders of the South Pacific do not welcome excessive labor when fruits are available that can be eaten the moment they are plucked or when the lagoons yield a variety of edible fishes. While a large complement of the villagers were gathering tons and tons of ape, a chosen delegation would prepare a huge *Umu*, in which it could be cooked.

On a level spot a short distance inland, a large square pit, thirty feet long, four feet deep, and fifteen feet wide, was dug. The dirt was piled about the sides of the *Umu* to an elevation of two or three feet and leveled in the shape of a sloping rampart. This would be utilized as an outer layer after the ape roots had been covered with numerous leaves, so as to retain the full flavor of the food. The oven was then ready for the fuel. Great quantities of dried palm leaves were packed into the bottom of the pit for tinder. Then faggots of *purau* (hibiscus) wood and guava, which had been thoroughly cleaned, dried, and

stripped of bark in sacred obeisance to the two Goddesses of the Sky and to Maui (God of Fire), were arranged on the tinder. To allow for good circulation of the fire, large green *purau* logs had to be placed in the oven, meeting in the center and resting at each end. Otherwise the palm leaves would be smothered by the great pressure of the boulders and would not continue to blaze freely until the larger pieces

of wood had caught fire. When the oven was at last ready for the rocks, boulders of lava, basalt, and volcanic stone, larger than a man's head, were placed on the pyre to a height of five or six feet.

The *Umu* was then ceremoniously lighted by a specially chosen *tahua*. Dances were held before the blaze, religious songs (*utes*) were chanted, and prayers were offered up before the oven by the *tahuas*. The *Umu* was then allowed to burn for two days, being tended constantly by the assistants, whose duty it was to rake out the ashes and turn and level the stones.

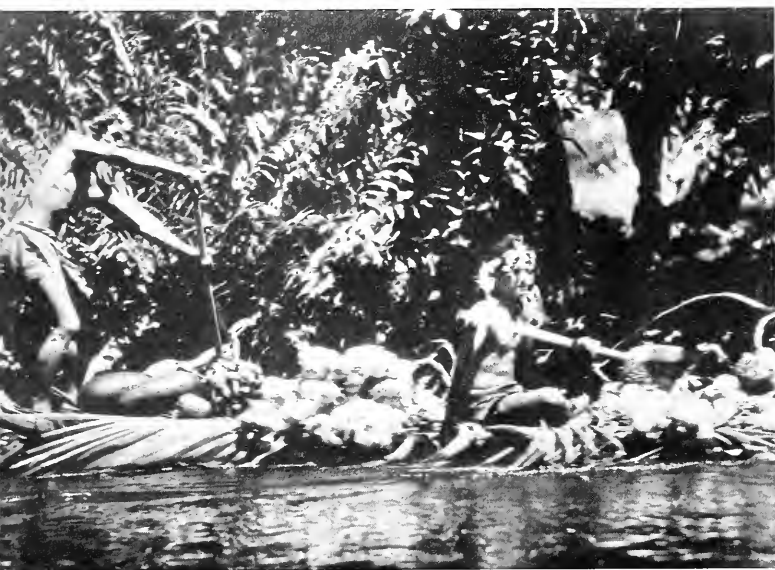
As the sacredness of the *Umuti* grew, the position of the fire tenders became one of great significance. They were generally selected by the high chief and were accorded the utmost respect. The *Umu*, as time progressed, became a place where the high chiefs met to discuss tribal affairs and where important visitors were received. The *Umu* of Polynesia was not unlike the Prytaneum of ancient Greece, which contained the state hearth.

The oven, burning for two days, heated the rocks to a high degree. When all the ashes had been removed, the stones fell to ground level. Upon the hot stones were placed the ape roots, together with the ti leaves, so as to give a sweet and appetizing flavor to the otherwise unpalatable taro root. The tubers were then covered with innumerable layers of banana leaves, breadfruit leaves, ape leaves, and



◀ CHIEF TERII-PAO walking onto the fiery pit, bearing his sacred wand of ti leaves

# the South Seas



▼ A SCIENTIFICALLY ACCURATE MODEL of a South Seas fire walker, on display at the American Museum

AMNH photo



finally with a heavy layer of earth to retain the heat. The *Umu* remained covered for ten hours, during which dances, songs, and speeches were given. When the dirt and leaves were removed, the ape and ti were taken by the women in large mixing bowls and mashed together into a glutinous pudding. It was then packed into long joints of bamboo and stored away so as to tide the villagers over the temporary famine.

As time went on, legend tells us, the *Umu* played an increasingly important part in their existence, and finally great interest was directed to the supposed power governing the fiery oven. Appreciative of the gift of fire, which enabled them to prepare the food in time of dire need, they showed their gratitude to the two great goddesses of ancient days—the highly reputed Hina-nui-te-a'ara (Great Gray of Scented Herbs), who became Goddess of the Moon, and Vahine-nui-tahu-rai (Great Woman Who Set Fire To The Sky). These two goddesses, as folklore maintains, were always dressed in shirts, garlands, and wreaths of the shredded green-and-yellow leaves of the ti plant, which emit a sweet odor and are held as a sacred symbol of the two goddesses.

Honoring these two goddesses

◀ COMMEMORATING a legendary release from famine, the fire-walking ceremony is accompanied by a great feast. Here natives are bringing fruits for the celebration that follows the rites

➤ PREPARING foods for the oven. The ceremony has solemn meaning, but the mood is otherwise light and gay, as at most South Sea festivals



and the God of Fire just before the food was placed upon the hot rocks, the native priest led his followers across the fiery pit, dressed in ti leaves, bearing wands of ti, and calling upon their departed ancestors to cast themselves upon the hot rocks to ensure safe transit. Today the ceremony is still enacted, though the *Umu* is prepared not because of famine but as worship to the two goddesses and Maui and for self-purification.

The *Umuti* of Raiatea was to be held in a valley a short distance from Ari's plantation. The location was not more than a half hour's leisurely stroll, so at three o'clock the next morning we started off in darkness. The jaunt to the *Umu* on this occasion is a memory I shall always cherish. The early morning air was heavily saturated with the exotic odor of flowers. There was deep silence, save for the distant booming of the great southern ocean over the barrier coral reefs of Raiatea. It was as if we were alone in an unknown paradise.

But as we journeyed up the valley, we met groups of natives, who cried out to us cheerily: "*Ia ora na! Maitai oe? Haere Umuti?* (Greetings! You are well and content? Do you go to the oven of the fire walk?)"

The short valley widened into



▲ SELECTED NATIVES level the incandescent stones in preparation for the fire walk



◀ CHIEF TERII-PAO chants to the Fire God and waves his wand of ti leaves over the fire pit. Bushes transplanted on either side of the oven are ti, sacred plant of the Fire God

➤ THE CHIEF traversing the hot stones barefooted and without special treatment to his feet







► DANCERS performing at the fire-walking ceremony

a large clearing bordered by coconut trees and lighted by candlenut torches. In the center was the *Umu*, piled high with large rocks. A great crowd of natives were squatting about the oven, smoking, chatting, singing, and laughing. The quivering shafts of light from the torches fell across broad, naked shoulders, momentarily revealing and obscuring handsome Polynesian faces. It was a spectacular sight.

On the far side of the clearing was a small thatched hut in which Chief Terii-Pao and his *tahuas* were praying to Maui. A few minutes after our arrival, Terii-Pao strode from the enclosure with his followers, and a sudden hush fell among the assembled natives. They hurriedly moved away from the *Umu* to the edge of the clearing, regarding the Fire-walking Chief with awe and reverence. He was a magnificent figure in the torchlight, nude save for a *pareu* and ti leaves about his waist. The fine head set upon sturdy shoulders, the noble features, with wide quivering nostrils and flashing eyes, commanded admiration and proclaimed him to be a favored son of Maui, the God of Fire. At the four corners of the



pit were transplanted ti plants, which remained green and unwilted even after the fire had burned for many hours.

Terii-Pao, after walking twice about the *Umu* to see that everything was in readiness, withdrew, and a *tahua*—a short, bowed man—slowly approached the fire pit, bear-

ing two sticks in the crook of his arm. He marched solemnly about the oven, chanting in a loud voice. Then, while the entire crowd chanted, he kneeled before a trench that had been dug into the oven for lighting the fuel and vigorously began to rub the two sticks together. As the lighting of the *Umu* is considered an extremely sacred part of the fire walk, the torch to set the oven ablaze must be kindled by rubbing two pieces of wood together.

The *tahua* had a difficult time obtaining a spark. He labored strenuously, and I could see by the glare of the torches that perspiration was streaming from his body. Suppressed laughter buzzed among the spectators. The *tahua* glanced about him with a peeved expression. Terii-Pao's face clouded with impatience and indignation.

Suddenly a flippant youth be-



◀ IN FIJI, as in the Society Islands, fire walking is also a sacred ceremony. Here are the head fire walkers of the island of Upolu



hind me cried out clearly: "*Na toe-toe te raau, na veavea te taata!*" which, translated, means: "The wood is cold, but the man is hot!" This cry was taken up by the crowd and continued until Terii-Pao, with a loud cry of "*Maniania!* (Be silent!)" approached the oven, took the sticks from the *tahua*, who sheepishly withdrew, and in a short time had a blaze with which to fire the *Umu*. As the dry tinder caught and the flames leaped high, the natives cried in a mighty chorus: "*E era!* (There she goes!)"

The two days necessary for the heating of the rocks sped by quickly. On the evening of the second day, we walked to the valley to see the *Umu* in darkness. I could feel the great heat 50 feet away. The shimmering pit of glowing fire recalled to mind the lava pits in the vicinity of Kilauea, in the Hawaiian Islands. The *Umuti* would be held promptly at dawn on the morrow.

Ari and I were back at the *Umu* at the first light of daybreak. The edges of the clearing were packed with natives of Raiatea and the adjoining isles. Old Polynesian grannies smoked and gossiped, occasionally breaking out in cackling laughter over some delicious morsel of scandal. Small children frisked about, got into mischief, and were spanked soundly. Young damsels flirted with gay lotharios of the islands. On every side was laughter and song. It was a happy and colorful gathering, typical of the light-hearted Polynesian spirit at festival time. A small group of tourists, who had arrived from Papeete the preceding day, stood a short distance away, carrying on a garrulous conversation concerning their "solutions" to the fire walk.

On the ramparts about the oven, on clean mats of woven pandanus leaves, were great mounds of the green-skinned, globular breadfruit.

There were yams, taro tops and pork, papaya poi, and fresh-water eels prepared with a sauce of fine wine. Indeed, a sumptuous feast was to follow the *Umuti*.

Terii-Pao suddenly appeared close to the *Umu*. His followers leaped to their feet behind him. I could feel the intense excitement that swept the clearing at his appearance. The Fire-walking Chief was a splendid figure among his assistants.

The group of tourists rushed over to Terii-Pao and surrounded him for an intensive inspection of his feet and whatever else might have been concealed "up his sleeve." He submitted indulgently, smiling at their thorough examination. One of the tourists turned suddenly and



▲ SAMOANS, too, have a fire-walking event. Here a *taupoo* (virgin) of the village chants to the Fire

God, hoping for assurance that the walkers will cross the fiery oven safely

approached the edge of the oven. Looking full into the pit for only an instant, he groaned, clapped his hands to his face, and backed away. The *Umu* was hot! Another tourist tossed a linen handkerchief upon the rocks, and in a second it was reduced to gray powder. And upon these stones the fire walkers were going to march with bare feet! The self-appointed board of examiners withdrew from the Chief with disappointed expressions. They had been unable to find anything suggesting trickery.

Now Terii-Pao, his head held high, walked toward the end of the oven nearest me, a branch of ti leaves in his hand. He halted at the edge of the oven and struck the rocks three times with the leaves, chanting in a low voice. His assistants, close behind, lifted their voices in the *Umuti* chant. Terii-Pao's voice became louder, and the great cords in his neck swelled. His eyes were still uplifted.

The chant was: "*E na ta'ata e tahutahu i te umu e, a ta pohe na! . . .*" and so forth.

Translated, it means: "O being (spirits) who enchant the oven, let it die out for a while! O dark earthworms! O light earthworms! Fresh water and salt water, heat of the oven, darkening of the oven, hold up the footsteps of the walkers and fan the heat of the bed. O cold host, let us linger in the midst of the oven. O Vahine-nui-tahu-rai, hold the fan, and let us go into the oven for a little while.

"Holder of the first footstep!

Holder of the second footstep!

Holder of the tenth footstep!

O Vahine-nui-tahu-rai! All is covered!"

I shall never forget the great sigh and then the hush that followed Terii-Pao's first step upon the oven. He hesitated a moment, as if to be sure that the stones would not shift under his weight, and then—he walked onto the hot rocks! He strode once across the pit and then turned and recrossed it. His followers formed in a line behind him when he returned. The spectators, native and tourist alike, were spellbound. Again the Fire-

walking Chief struck the stones with his branch of ti leaves. Terii-Pao and his *tahuas* walked with firm steps across the center of the *Umu*. I could see the great heat waves rising above their heads, but there was no odor of burning flesh as I had half expected. They had traversed the oven now, and Terii-Pao raised his ti leaves to signal the column to about-face and march back over the pit. They traversed the *Umu* three times.

Following the third crossing, Chief Terii-Pao called out, "*Atira! (Enough!)*"

Then he quickly turned and *crawled across the oven on his stomach!*

On the other side, Terii-Pao stood up and faced the astounded tourists. They, understanding that he was ready to be examined, gathered about him. The Chief and his followers lifted their feet, so that they could be viewed and handled. The soles, as I could see, were not even marked, and one tourist who placed his hand against them announced that they were "cold as ice."

Now Terii-Pao exhorted the natives to follow him across the *Umu*. Passing close to me, he caught my eyes, grinned, and said, "Will you not walk behind me on the oven? You have lived long in our islands and understand our customs. You will surely not be harmed if you follow close behind me, keep your head up, be quiet, and don't stumble."

"Why don't you?" yelled the tourists.

"*Haere! (Go ahead!)*" urged Ari and the assembled natives.

"*Tu, tu, tu, el (Come, come, come!)*" persisted Terii-Pao.

I cannot say that the prospect of walking on the hot stones was agreeable to me, and I wavered. Terii-Pao gave me a broad smile, which might have meant, "Are you afraid?" It was this that prompted me to kick off my sneakers, remove my socks, and cry, "*Haere otou! (Let's go!)*"

A great shout of approval came from the native spectators.

I stepped into line behind Terii-Pao. There was a taut feeling in the pit of my stomach. My heart

was beating hard, my head ached, and I wanted to bolt. I have always had a great fear of fire, and now that fright was intensified. The *tahua* behind pushed me gently. Terii-Pao had started!

I gritted my teeth and groaned inwardly. I began to walk mechanically. Every step I rebuked myself: "You fool, now look what you've let yourself in for!" My legs felt numb and leaden. Then my bare feet touched something uneven and elevated. In the next instant, countless tiny electric shocks struck the soles of my feet. It was like the sudden contact of the skin with sharp needles. Great heat waves rose about my head, compelling me to half close my eyes. It was not unlike the sudden blast of heat that strikes one when opening the doors of a huge furnace. I had experienced this sensation while standing on the grilled platform above the huge, throbbing engines of an ocean liner, with billows of oily heat taking my breath.

The heat of the oven all but suffocated me. I was unable to draw a normal breath. The heat waves affected the membrane of my nostrils. My lungs became strained, and I feared that I would choke if I did not breathe pure air quickly. From a great distance I could hear the murmuring of the crowd.

Then, suddenly, the prickly sensation on the bottom of my feet ceased, and I knew I had arrived at the far end of the *Umu*. The last in line had not crossed the pit, so we continued walking across the clearing in a straight column. I glanced briefly down at my feet. They were untouched! There were no traces of searing or blistering. I could hardly believe my eyes. My shirt was wet, and I could see that Terii-Pao's broad back was streaming with perspiration. Suddenly, he raised his wand of ti leaves, a signal that the last man had passed over the *Umu* and that everyone should right-about-face for the return trip.

I knew that I could not stand another trip across the hot stones, so I stepped quickly out of line. Terii-Pao smiled and patted me on the back understandingly. The fire

walkers moved onto the oven again, and I was left standing 20 feet away, dazed and trembling from head to foot. The tourists grouped about me, highly excited, screaming questions at me from all sides. I had no solution to offer.

Later, Ari and I returned to the valley of the *Umuti* and became perfect gourmands at the bountiful banquet of South Pacific ambrosia heaped before us on tablecloths of banana leaves.

How do I explain fire walking?

First, I suppose there is the control of mind over matter. No one can view the performances of the authentic fakirs of India without believing that a person can develop special control over portions of his anatomy, and it is undeniable that one's reaction to pain depends a great deal upon his state of mind. Rocks of highly porous lava are known to resist the passage of heat, and this may be a fairly important factor in the fire walk. Also, the toughness of one's feet from walking barefooted on the beach would certainly make a difference.

Still, there has to be a more complete explanation for the fire walk. Some years ago the celebrated magician and escape artist, Harry Houdini, made a specialty of unmasking spiritualistic tricksters by

explaining the seemingly unexplainable. He asserted that the most complicated trick is the easiest to see through and the simplest the most baffling. As the simplest trick in the world, he offered a young man who permitted himself to be roasted alive.\* This trick was so completely simple, he said, that it was practically impossible to see through.

The man permitted himself to be placed in a glass compartment

\* Described in *Miracle Mongers and Their Methods*, E. P. Dutton, 1920.

about the size of a telephone booth, the interior of which was made hot enough to cook a steak hanging over his forearm. He was naked except for swimming trunks. He applied wet clay to his eyebrows and fingernails and wore a cup over his hair. Spectators could scarcely believe their eyes when they saw the fat of the steak start to sizzle and drip to the floor, while the man holding it showed no sign of pain or discomfort. When the steak had cooked long enough to be medium

*Continued on page 48*



*Photos from the Univ. of California at Los Angeles*



▲ RECENT scientific tests show that a human being can endure far more heat than had been imagined. Here volunteer Sidney Friedlander is being wheeled into a specially devised heat chamber for heat tests at the University of California at Los Angeles

◀ THE SUBJECT perspires copiously as the thermometer creeps past the 200-degree mark. But perspiration is what saves him—the cooling effect of evaporation from his skin. Professor Craig Taylor, supervisor of these experiments, endured 151½ minutes at temperatures between 230 degrees F. and 262 degrees F.

# WINTER

## *Through the Camera's Eye*

By JOSEF MUENCH

When King Winter casts his spell, mountain and desert voice no humble mood

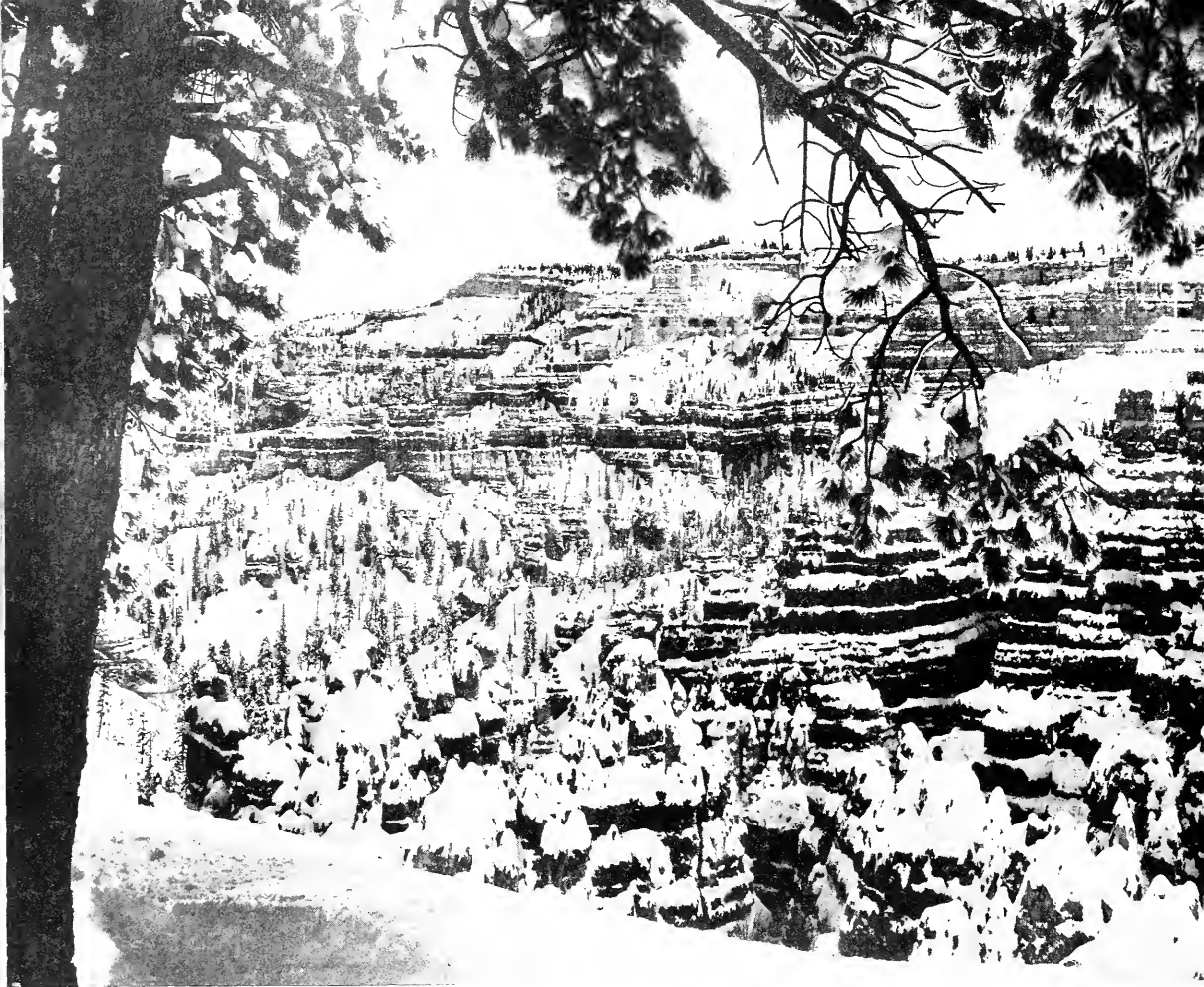




◀ **SKI TIME.** Only the tracks of the hardy break the white blanket that covers the slopes of Mt. Superior in Little Cottonwood Canyon, Utah. Many skiers are drawn to Alta, one of Utah's favorite resorts

▲ **WHITE GHOSTS** at Bryce Canyon. Balancing on the rim of this natural amphitheater, two evergreens wear the garb of winter and give an unaccustomed aspect to a scene familiar to many in warmer weather





► WINTER SHADOWS in Navajo Land. A weak sun throws its shadows at the gate to Goulding's Trading Post. Monument Valley is farther from a railroad than any other point in the United States





◀ THE ERODED figures of Bryce Canyon, spired with evergreens, create a new and stranger fantasy when winter rules the land



▲ A LONELY BUTTE in Monument Valley, framed in the gnarled boughs of a cedar. Even this hot and

arid region dons a lacy costume and becomes a part of winter's fairyland



WHEN COMBED OUT, ramie fibers reveal a snowy luster like that of silk, and they are seven times as strong.

AMNH photo

# The "Wonder Fiber"

## Ramie

DURING the past century or so, adventurous investors in almost every country in the world have poured out millions of dollars in a vain attempt to exploit ramie (*Boehmeria nivea*), that fascinating Asiatic perennial which is perhaps the oldest fiber used by man. In a textile sense, ramie has everything, but it has long been a terrific headache to both farmers and textile people because it is a "wonder fiber" that never quite made good—a self-propagating crop with an enormous potential that somehow couldn't make the grade.

Ramie—a shrub belonging to the stinging nettle family but without the stinging hairs common among nettles—sends up tough stalks that are from five to eight feet high. Lying directly underneath the bark of each stalk is a thin layer of individual fibers. Inside this ring of fibers is the woody part of the stalk. It is the fibrous part of the plant

Far superior to cotton or linen, it was used by the Egyptians for mummy wrappings. But only now do its remarkable properties promise to become of widespread benefit to man

By EUGENE W. NELSON

that has interested the textile industry, since these fibers possess truly remarkable properties.

### Stronger than Cotton or Silk

Ramie is a "bast" fiber, like hemp or linen. That is, the fiber is produced from the stalk and not, as in cotton, from the bloom. In tensile (or pulling) strength and also in resistance to mildew and rotting,

ramie is far superior to cotton or linen. In fact, it has eight times the strength of cotton and seven times the strength of silk. Paradoxically, when ramie fibers are wet, their tensile strength is from 60 to 70 per cent greater than when dry. Moreover, these fibers can be combed out almost to the fineness of silk, and their beautiful, snowy-white luster resembles that of silk. Ramie fibers take dyes well and

hold colors better than do most fibers. The plant itself is easily grown in our southern states and in many other parts of the world.

### Problems in Commercial Production

The Egyptians used ramie fiber for wrapping mummies, and this plant was mentioned in the Imperial Chinese Treatise on Agriculture in 2200 B.C., but to date the production of ramie fiber on anything resembling a commercial scale has been limited to oriental countries having cheap labor. The major fly in the ramie ointment, as far as mass production in the occident is concerned, has been the lack of efficient methods for mechanical decortication. Decortication is the process of removing the

bark and pith surrounding the ramie fibers without damaging the fibers themselves. In China, decortication is all done by hand, the workmen scraping the ramie fiber from the green stems with crude implements. In this way, one worker can separate only a few pounds of fiber each day. In our country, of

course, any kind of hand process for an operation of this nature would be prohibitively expensive.

Another trouble has been the cost of harvesting a ramie crop. When growing naturally, some ramie plants mature before others, even though all of them were planted at the same time. Even parts of



*Courtesy of Newport Industries*

▲ FRESHLY CUT RAMIE. The fibers are located in a layer between the bark and woody part of the five- to eight-foot stalks

► MOTORIZED COLLECTION of harvested bundles of ramie



*Photo courtesy Fiber Conversion Corp.*

▲ UNIFORM GROWTH OF THE CROP, recently attained through careful study, makes mechanized harvesting possible. Previously, mature plants had to be selected by hand

*Florida Pictorial Service*





*Courtesy of Newport Industries*

▲ RAW FIBER (right) and degummed fiber (left)

the same cluster will be of a different height and state of maturity. In the past, this has made hand harvesting obligatory and has practically ruled out mechanical harvesting. Recently, however, careful cultivation and fertilization, the use of superior drainage and water control, and over-all good management have smoothed out this uneven growth. Today, ramie plants cultivated in the United States have an even, steady growth that makes mechanical harvesting practical at last.

### Processing

With the harvesting problem simplified, there still remained the need for an efficient mechanical decorticator and degumming process. The lack of such a process has been the great holdback to widespread production and use of ramie in this country. Without such a process, no American industry could possibly compete with oriental coolie labor. Nor could an industry be built in this country without uniform quality in the raw material.

Scores of inventors have dreamed up decorticator machines and degumming processes—and in their dreams have become fabulously rich from selling the hard-wearing, shrinkage-resisting “wonder fiber”

for use in tire cord, industrial fabrics, and a host of other things.

Machines designed for scraping away the bark and pithy core of the ramie plant from the valuable fibers have been of two general types. There is the larger, centrally located type of decorticator that is capable of separating the fibers from the stems of plants grown on thousands of near-by acres. The other type is a smaller, portable machine that can be set up in the fields where needed.

Now, at long last, comes convinc-

fibers at a cost equal to that of the Chinese product.

With solution of the major problems in the growing, harvesting, and processing of ramie fiber on a large scale—what then? Just what sort of a fate lies in store for the erstwhile “problem child” of the textile world? Just a few of ramie’s possibilities include corduroy that is definitely better than the standard cotton corduroy, inexpensive suits that can’t be distinguished from all wool, and conveyor belts and other industrial fabrics for use



*Courtesy Fiber Convers*

▲ REMOVAL OF GUM and woody particles is an important step in the preparation of the fibers for spinning and weaving

ing word that ramie has finally arrived and will be going places at an ever-increasing pace in the next few years. One of the companies that has been going in for ramie research in a large way has quite recently announced the perfection of a decorticator with a proved daily capacity of 20,000 pounds of ramie fiber. One of these machines (and perhaps more, by now) has been built and is in operation in Florida, where several companies have been growing ramie on a large scale in the rich muck of the Everglades. Ramie technicians claim that they will soon be able to produce ramie

where “wet strength” is important. Because it is stronger when wet, ramie also makes superior cordage, fishing nets, and sails. Longer-wearing sheets, pillow cases, toweling (ramie absorbs water even better than cotton does), and draperies as well as bandages, upholstery fabrics, and carpet backing are also on the ever-growing list of uses for ramie fiber. Bank-note paper having better wearing qualities than the kind now being used is still another possibility. In fact, it is a matter of sober record that ramie fiber is adapted to the widest range of uses among known textiles.

Ramie can be used alone or in combination with cotton, rayon, and wool. When combined with rayon, for instance, ramie produces a material for shirts and summer dresses that absorbs perspiration and then dries out very quickly.

### Wide Uses

The fiber, however, is only a small part of the entire plant, according to the ramie experts. Here are some of the uses recently discovered by chemists for the rest of the plant after the fibers have been extracted. Ramie leaves and stalk tops make a cattle feed especially rich in carotene (for vitamin A) and protein. Its yield per acre is said to be higher than any other protein-producing vegetable. Ramie sauce for cooking is claimed to have a salty meatlike taste. It has been suggested that this sauce will be a boon to people who are on a saltless diet. And ramie "waste" has been forced to yield such valuable chemicals as chlorophyll, xantho-

phyll, and industrial proteins—all potentially valuable in chemical processes.

The most recent developments have had to do with uses for ramie gums. The major component of ramie gum is pectin. This substance is widely used in the food and cosmetic industries. It is also useful in the sizing of cotton yarns and fabrics and in adhesives, cleansing agents, printing inks, and a host of other industrial products. The chief sources for pectin in the United States have been apples, citrus rind, and grape pulp. In Europe, enterprising producers have turned to lower-cost sources, such as sugar beets, vegetables, flax, and ramie, which, although they yield a pectin that is lower in jellying power (the most important property for the food industry), provide inexpensive pectin that is highly satisfactory for technical and industrial purposes.

Ramie may play a part in the reconstruction of oriental countries damaged by war. The Philippine

Government has engaged the services of one of the large American firms interested in this plant and are now making a complete survey with the view to recommending establishment of a fully mechanized ramie industry in the Islands. Several other countries where ramie has been grown successfully are reported to be considering similar steps.

Ramie is usually propagated from rootstocks, or rhizomes, although it can be grown from seed. When starting a new field, sections of rhizome four inches long, each having several eyes, are set at two-and-one-half-foot intervals in rows four feet apart and covered with about two inches of soil. These rhizome sections usually burst into life within two weeks.

During the first year in a new field, the weeds have to be controlled. After that, the perennial usually becomes so well established that it crowds out all other growths so that weeds are no longer a headache. Ramie rhizomes ordinarily send up a new growth each spring. But if the stems are cut during the growing season—which in Florida lasts for eight months out of the year, from April to December—a new crop starts to grow at once. The shrubs may reach a height of from five to eight feet within a period of about two months. Thus, under favorable conditions, three or even four crops may be obtained each season for ten years or even longer without replanting. A crop like that is enough to make any farmer's mouth water.

In the various ramie fields now under cultivation in Florida, the crop is harvested by a special combined harvester and binder which delivers stalks in 50- to 60-pound bundles. After the bark and pith have been removed in a decorticator, the waxes and gums are extracted chemically from the remaining fibers. The ramie is then dried and baled and may be processed as any other fiber.

It is quite possible that this ancient plant may provide a new crop of major importance and a source of additional wealth for our southern and southwestern states.



*Florida Pictorial Service*

▲ **BALED FOR SHIPMENT.** The fiber that was known to the Chinese 4000 years ago is just now trying its strength in world industry





◀ SINCE THE MURRE has relatively small wings for its heavy body, its flight is rapid and direct. Here the bird puts on all air brakes, back-pedaling with rapid wing strokes while presenting its flat underside to help cut down its forward speed

# Mu

## MARINERS OF

Hardy and seaworthy, they  
 the northern sea and  
 on the wind-lashed cliffs

By KARL K  
 U. S. Fish & Wildlife

Photographs by the author

ONE chilly afternoon in July, I stood near the brink of a sheer 200-foot cliff on the Island of St. Paul, in the Pribilof group in Bering Sea. At my feet the yellow arctic poppies buried their heads among the long whipping strands of rye grass, as a wet wind bent its force over the cliff's edge. Below, roaring breakers pounded a beach littered with black volcanic rock, tossing aloft a curtain of salty spray that joined the fog-laden wind rushing down from the northwest over the dismal, gray surface of the Bering Sea.

Like missiles from some hidden flotilla, the dripping wind bore thousands of birds toward the mist-shrouded cliffs. Each bird headed instinctively through the blinding fog to a certain nesting ledge or cranny. In endless streams the birds arrived. Each individual skimmed

low over the surface of the sea until within sight of the nesting cliffs, then gracefully zoomed upward in a steep curve, losing speed before it deftly settled among others of its kind already crowding the ledges. As constantly as new birds arrived, others streamed away toward hidden fishing grounds.

Most of the birds thus approaching and leaving the cliffs were Pallas Murres, with a few California Murres. The vertical updrafts near the cliff's top swarmed with a cloud of other kinds of birds. Screaming kittiwakes, soaring fulmars, and clumsy, inquisitive puffins predominated in this milling mass. The murres spent no time drifting about. They flew directly from cliff ledge to the open sea. Having a comparatively heavy body and small wings, the murre is specialized for swimming rather than

Photo by Dick Bolding



flight. Even in executing necessary aerial maneuvers the murre must go beyond the use of the structures designed strictly as implements of aerial control.

As many of the birds launched themselves into the air, they used their feet as supplementary horizontal stabilizers. Apparently the tail is so small that at low speeds it does not offer adequate control surface. This is especially noticeable when the birds are leaving a cliff or the surface of the water. Thus, while taking off, the murre frequently spreads both its webbed feet, holding them flat and stiffly extended on each side of the tail where they supplement its action, providing additional control.

In addition to employing its feet

◀ ON TINY volcanic Bogoslof Island in the Aleutians, murres crowd all rocky areas, because there are no predators to molest them



► A PAIR of courting Pallas Murres pose for Dr. Scheffer's camera. They appeared so interested in each other that they completely ignored their human observer



res -

## THE NORTH

survive the rigors of  
precarious existence  
s of the Pribilofs

KENYON

Life Service

ss otherwise indicated

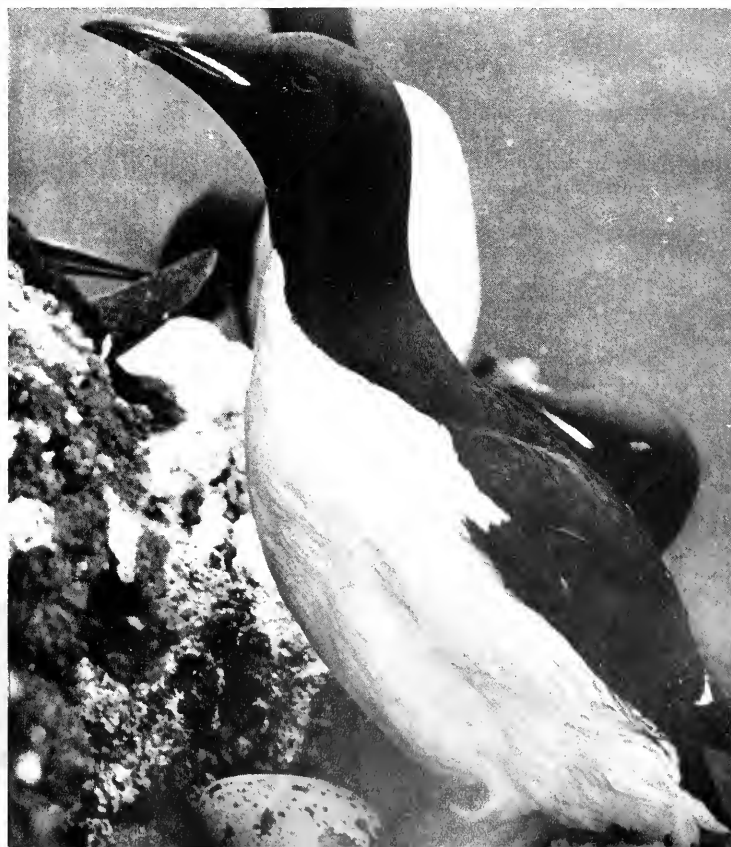
to supplement its aerial equipment, the murre uses its flying equipment under water. It depends on its wings to increase speed while pursuing the fishes upon which it lives. As we approached the Pribilof Islands by ship many murres took to the depths as a means of escaping the oncoming vessel. As they headed down through the dark water near the bow, our view of their wildly flapping wings showed clearly how useful these members are under water.

Being a bird of the open sea, the murre appears most at home on or beneath the surface of the water. The break from an aquatic to an aerial environment is accomplished awkwardly. In order to gain flying speed the bird usually patters

across the water, using its feet to help the rapidly beating wings. It may continue thus for many yards before it is able to lift its bulky body a few inches above the surface. Some drop heavily back, apparently reluctant to make the final effort. Still others appear to make no attempt to become air-borne but, using their wings as giant oars, simply hydroplane on their breasts a safe distance from an approach-

ing ship, then settle back on the water again.

Murres sitting bolt upright in rows along the cliffs resemble small penguins. Their black backs and white breasts add to their masquerade. However, murres and penguins are widely separated, anatomically as well as geographically. Murres are circumpolar in the northern hemisphere, penguins in the southern. The two groups never



► PALLAS MURRES sharing one of Bogoslof's nesting cliffs



◀ THE WHITE "MUSTACHE" identifies this bird as a Pallas Murre. The sharply conical shape of its egg helps to prevent it from rolling off the 300-foot drop

▲ THE MURREs generally lead a quiet life, spending a good deal of time affectionately caressing their mates with their bills

mix. Murres, like many other aquatic birds, have their legs placed far back on the body as an aid to rapid locomotion under water. The upright standing posture that results from this arrangement appears to offer several advantages to the murre in its particular way of life. The bird is thus able to stand upright on a tiny ledge of cliff that would otherwise be too small for it.

On this particular day, as I stood at the brink of the cliff, I witnessed another advantage in this upright

posture. Seeping moisture had loosened a small portion of the cliff edge, which suddenly gave way. Perhaps a bucketful of loose earth and small pebbles showered down over the rows of courting and incubating birds. I expected them to leave their ledges and seek safety in the air. However, I was surprised to see that instead, the murres stood in close to the cliff and pointed their bills upward. In this way they successfully dodged the larger pebbles and "streamlined" themselves against the smaller debris, which pelted their thick feathers but rolled off as harmlessly as "water off a duck's back." They thus saved their eggs, with no apparent discomfort to themselves.

St. Paul's moisture-sodden cliffs are constantly crumbling. As the storm-driven waves eat away their bases, the summer melting of snows loosens rocks and earth. Chunks break away, leaving the narrow ledges and shelves upon which the

murres lay their eggs. Murres do not built a nest. The eggs are, fortunately, particularly tough-shelled and seldom break even though they rest on the bare rock. As they lie in rows along a ledge of black rock, they form a colorful array, ranging from nearly white through various shades of blue and green, marked with dark lines and smears. Their sharply conical shape is an advantage on the narrow ledges where they are laid, because it causes them to roll in a tight circle, lessening their chances of falling from the cliff. In spite of this, many go over the edge if the murres are suddenly frightened into the air.

On the island of Bogoslof, in the Aleutian chain, I suddenly rounded a rocky outcropping and came upon a murre colony unexpectedly. The birds stampeded toward the sea, sending several eggs bouncing from their resting place down a 20-foot slope. Although some were broken, I examined others that had survived enough tumbling to shatter any ordinary egg and found that their tough shells were only slightly dented in a few spots.

The view of a cliff covered with murres generally presents a peaceful if constantly moving panorama.

◀ ALEUTS have gathered murre eggs for many years. Although this looks like quite a load of eggs, it is only a small fraction of the tremendous number to be found on Walrus Island



Photo by Y. B. Scheffer

For the most part the birds lead a quiet domestic life, spending a good deal of time affectionately caressing their mates with their bills and making soft vocal sounds reminding of a somewhat muffled human chuckle.

However, the ledges appear sometimes to become too crowded for the tolerance of even these patient creatures. One rare afternoon when the sun had dispersed the persistent fog and the cliffs and meadows glistened above the sea in unusual brightness, I watched the customary flow of birds to and from the cliffs. A sharp, raucous squawk attracted my attention to a pair of murre engaged in an argument over a small ledge. They were insistently crowding each other for possession. One suddenly jabbed his neighbor with an angry peck, precipitating a violent emotional outbreak. Each bird grabbed a billful of the other's feathers. This threw both off balance and plunged them in a tangle of wildly thrashing wings, necks, and feet into the gusty sea breeze. Even the fact of

their falling seemed not to affect their feelings. Not until the struggling pair had dropped 50 feet or more did they separate, spread their wings, and head out to sea. This was still not the end of the battle. Both birds had barely gained aerial control and were flying a few feet apart when the aftermost uttered an angry cry, accelerated rapidly, reached forward, and grasped the leader's flank feathers. Twisting and jerking sharply, this aggressive action caused both to swerve giddily and lose several feet of altitude before they separated again. Still unsatisfied, the trailing bird again speeded up, bumping the other from behind. For a moment wings and feathers were mixed, but when the two separated the fight was over and they moved quietly out to sea, apparently having forgotten what the quarrel was about.

Murres' eggs are a valuable asset to the Pribilof islanders. After a long, cold winter with little fresh food, the spring trip to near-by Walrus Island, a flat-topped rock about a third of a mile long, is a



Photo by Dick Bolding

▲ A SHEAR NESTING CLIFF on Bogoslof Island in the Aleutian chain



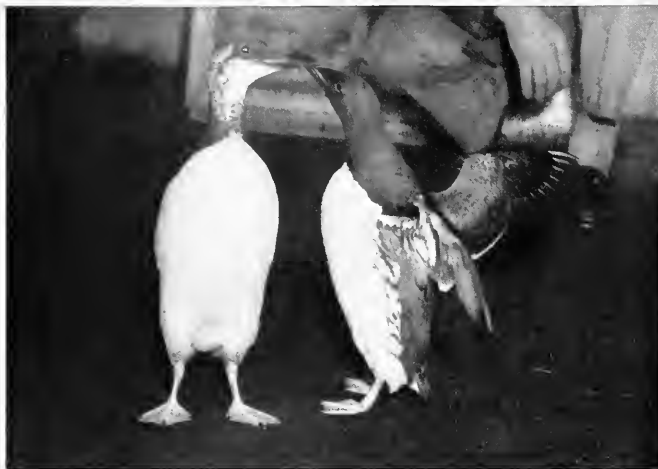
▲ BLUE FOXES like this one gather the few murre eggs injudiciously laid within their reach along the cliffs of the Pribilof Islands

➤ THEY SCATTER the eggshells after breaking the eggs and licking out the insides

very important affair. Here the nesting murre cover every available inch of rock. The skiff-load of eggs gathered is only a fraction of those available, and since the birds will lay a second egg about nine days or more after the first is taken, this egg-gathering is not detrimental to the murre population. After many years of such expeditions the birds continue to cover every available nesting spot every season. Murres' eggs, unlike the distasteful eggs of such fish-eating birds as the cormorant, closely resemble ordinary chicken eggs both in flavor and consistency.

Murres' eggs are so palatable, in





◀ THE RESEMBLANCE of these California murrets to penguins is purely coincidental. They have lived at the Seaside Aquarium in Oregon since they were rescued from the beach in an oil-soaked condition

fact, that their wholesale exploitation for the public markets during the early days of American settlement nearly caused their extermination. From 1850 to 1856, between three and four million murre eggs were taken from the Farallon Islands to the markets of San Francisco. The second egg laid by the birds was not left for hatching in those days, and when the murrens began to disappear, they were given legal protection and have now resumed their former place as one of the most numerous sea birds within their range.

While murrens are hardy birds, accustomed to the rigors of the sea, they are unable to cope with certain conditions imposed on them by human carelessness. Oil lost or dumped from ships at sea saturates their feathers, and thousands perish every year when they lose their buoyancy and power of flight as a result. Two California murrens that survived this usually fatal condition are Gus and Joe, of the Seaside Aquarium, Oregon. Mr. George P. Smith, owner of the aquarium, has rescued many such unfortunate sea birds from the beach, cleaned their feathers with castor oil, then liberated them. Gus and Joe have stayed and apparently feel quite at home either in their tank or following their savior about the premises. Gus has been there for nearly ten years and Joe for four.

One of the most interesting of the murrens' natural enemies on the Pribilof Islands is the Pribilof blue fox. These foxes, which inhabit the three largest islands of the group,

force the murrens to nest only on the inaccessible faces of cliffs. I noticed one day, soon after the egg-laying season began in early July, a scattering of broken murre eggshells near the edges of the cliff. At first I thought that a human marauder had placed them there. Later I noticed that they were nearly always located near fox trails or dens. On several occasions I watched foxes as they crept along ledges, seemingly too narrow for even their slender bodies, searching every likely spot for eggs. The fox carries the egg in its mouth to the top of the cliff, there bites a hole in it, and then proceeds to lick the shell clean. The Aleuts say that it is not unusual to find the body of a fox below a nesting cliff, where a tantalizing egg had apparently led the animal beyond its better judgment.

Newly-hatched murre chicks are cagey little creatures, distinguished mainly by their large feet and loud, piercing chirp. They are no sooner free of the shell than they turn their backs on the sheer drop and instinctively press close to the wall of their narrow ledge. I wanted a young chick to photograph, so descended via rope one afternoon to a convenient ledge. I found that taking a downy chick from its mother was not an easy task. In the first place, my footing was none too solid, and in the second place the reluctant parent refused to leave her charge. Finally I pushed her forcibly from the ledge and was then able to grasp the struggling chick. Expecting that, once evicted,

the old bird would stay away for a while, I gave her no second thought. But I had just started for the top of the cliff when she swished to a landing at my elbow, missing me by an inch or two and adding another gray hair to my head.

After finishing my photographic efforts, I found her still waiting and eager to reclaim her lively offspring. The chick lost no time in availing itself of the warm shelter of its mother's breast feathers.

Within a few weeks after hatching, the contour feathers grow, pushing away the down, and the young murre takes on the appearance of a miniature adult before making his long plunge to the sea below.

In spite of their hardiness and seaworthiness, few murrens attempt to withstand the rigors of the Bering Sea in winter. As the winds increase in velocity in the fall, lashing the seas against the black Pribilof cliffs, the murrens, both old and young, head southward toward the Aleutian chain. Sometimes the first autumn storm strikes with violence before they leave. If such a gale catches the young birds while they are leaving the cliff, great numbers perish.

Early in September I hiked from the village to a near-by nesting cliff. A cold, driving wind swept in from the west. The ledges that only a few weeks before had swarmed with a host of birds now held only a half-dozen stragglers. These cringed close to the rock wall in the face of a chilly wind. The wind had swept the mist away, and the fields of yellow poppies were now gone. The thick carpet of rye grass, undulating and shimmering in the cold northern sun, stretched back from the cliff. That night the first real fall storm of the year broke, but the murrens were safely away to the south.

# THE Peripatetic TOAD

The Giant Neotropical Toad provides one of the most unusual chapters in the history of man's efforts to enlist the services of wild animals

By JAMES A. OLIVER

Department of Biology,  
University of Florida

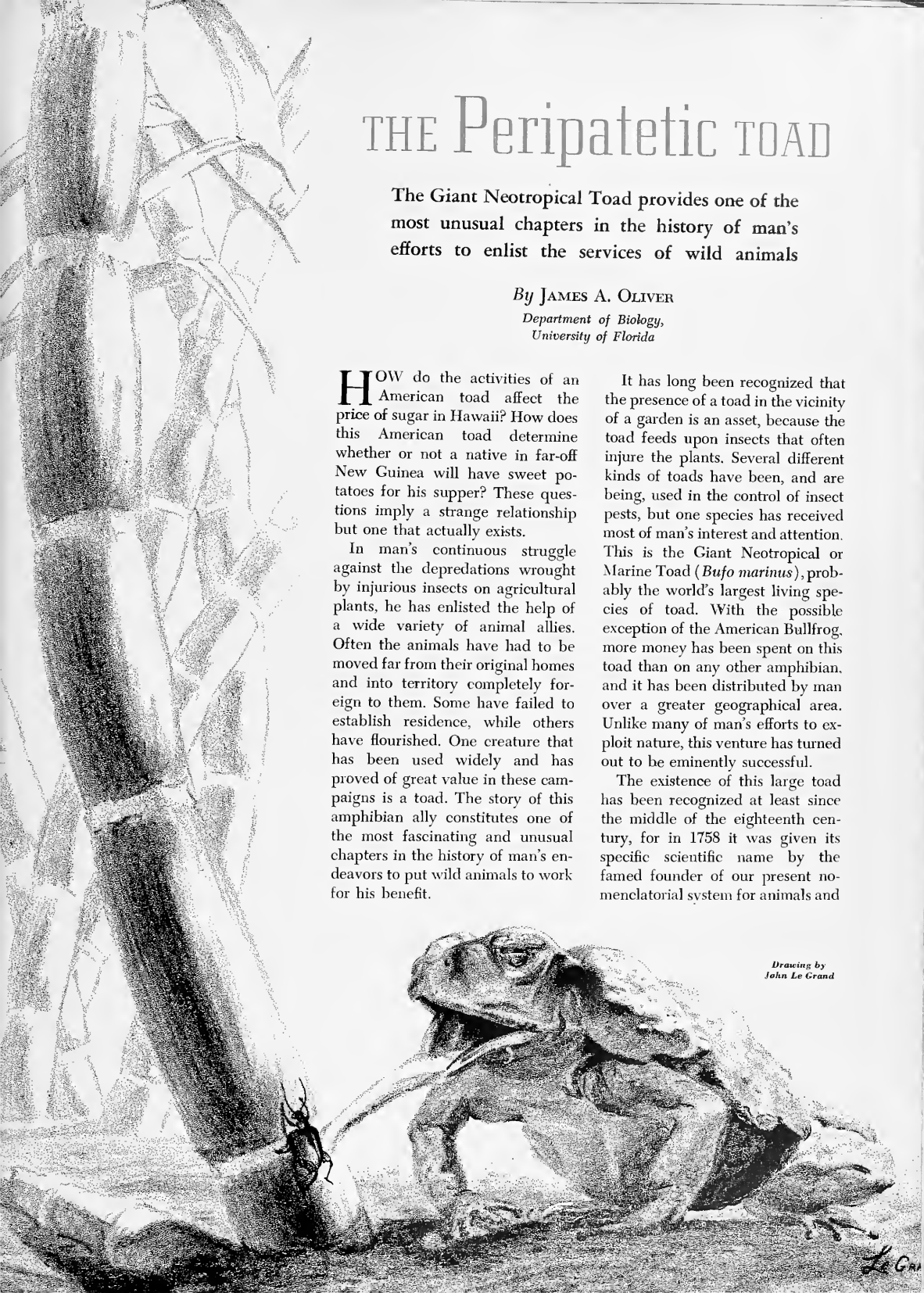
HOW do the activities of an American toad affect the price of sugar in Hawaii? How does this American toad determine whether or not a native in far-off New Guinea will have sweet potatoes for his supper? These questions imply a strange relationship but one that actually exists.

In man's continuous struggle against the depredations wrought by injurious insects on agricultural plants, he has enlisted the help of a wide variety of animal allies. Often the animals have had to be moved far from their original homes and into territory completely foreign to them. Some have failed to establish residence, while others have flourished. One creature that has been used widely and has proved of great value in these campaigns is a toad. The story of this amphibian ally constitutes one of the most fascinating and unusual chapters in the history of man's endeavors to put wild animals to work for his benefit.

It has long been recognized that the presence of a toad in the vicinity of a garden is an asset, because the toad feeds upon insects that often injure the plants. Several different kinds of toads have been, and are being, used in the control of insect pests, but one species has received most of man's interest and attention. This is the Giant Neotropical or Marine Toad (*Bufo marinus*), probably the world's largest living species of toad. With the possible exception of the American Bullfrog, more money has been spent on this toad than on any other amphibian, and it has been distributed by man over a greater geographical area. Unlike many of man's efforts to exploit nature, this venture has turned out to be eminently successful.

The existence of this large toad has been recognized at least since the middle of the eighteenth century, for in 1758 it was given its specific scientific name by the famed founder of our present nomenclatorial system for animals and

Dracing by  
John Le Grand





plants, Carolus Linnaeus. Prior to man's meddling with the toad, it inhabited the warm subtropical and tropical areas of mainland America from the extreme southern portion of Texas to northern Argentina. It was absent from the West Indies except on such continental islands as Trinidad and Tobago. Early in the nineteenth century, the planters of the West Indies became aware of this giant among toads and believed it might be a desirable addition to the islands. At some unrecorded date prior to 1844, a number of adult toads were transported from French Guiana to the island of Martinique and liberated there. This appears to be the earliest reported introduction of the animal, although the exact year is not known. From Martinique, the toads were carried to the British West Indies, and they ultimately reached virtually every island in this area where agriculture is of importance.

The presence of the Giant Toad in the West Indies reputedly resulted in a marked decrease in the numbers of many of the noxious

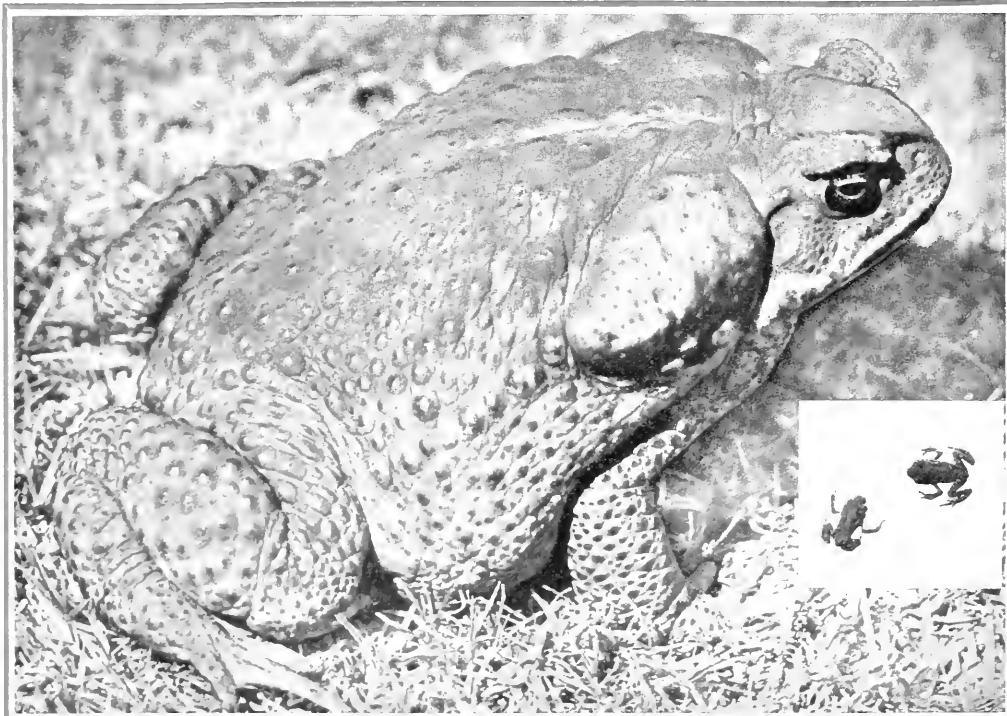
insects. Scientists of the Hawaiian Sugar Planters' Association eagerly studied reports on its excellent performance in reducing the white grub pest of sugar cane in Puerto Rico. By 1932, they were convinced of its value, and Mr. C. E. Pemberton, the entomologist in charge of the study, traveled to Puerto Rico to obtain some of the toads for introduction into the Hawaiian Islands. Mr. Pemberton gathered 148 adult toads, packed them in his suitcase, and hustled them off to Honolulu by airplane. The animals were released at two localities on the island of Oahu. Here they increased rapidly, and in a little over two years, more than 100,000 descendants of the original 148 toads were distributed to various localities in the Hawaiian Islands. Other descendants of the original immigrants have now been carried throughout the Pacific area as far as Formosa, the Philippines, New

Guinea, and Australia. Reports from all of these regions attest to the effectiveness of the toad in curtailing the activities of the important insect pests of sugar cane and other crops.

Toads are well suited to help man in his fight against the injurious insects, because they are not restricted to wet situations as are many amphibians and because, unlike most insectivorous birds, they feed at night when many insects are abroad. The Giant Toad was selected chiefly because of its large size. The females grow larger than the males, and the largest one I know of is a specimen from British Guiana that has a head and body length of nine inches, not including the enlarged hind legs. This is equal to the maximum size reported for the Asiatic Toad (*Bufo bufo gargarizans*) and makes these two species the outstanding contenders for the title of "largest toad

▼ AN ADULT, sixteen and one-half months old, compared with three-day-old toads. This represents an increase in weight by nearly 5000 times

Photo courtesy C. E. Pemberton and The Hawaiian Planters' Record





in the world." A specimen with a length of seven to nine inches would fit snugly into the crown of a man's hat! Size is a useful quality for a predator of insect pests, because the larger the toad the more insects and the larger insects it can consume. An investigator in the Hawaiian Islands raised some toads from a size of less than one inch to a length of six inches in sixteen and one-half months. During this time, each toad was estimated to have eaten 1500 to 2000 insects of various sorts. A toad of such large bulk also has fewer enemies than the smaller forms.

The earliest experiments in the use of this toad were apparently casual ventures conducted by trial-and-error methods. But in recent years, careful scientific investigations have been made into the habits, life history, and best methods of raising this creature. As a result, there is now a rather extensive knowledge of the Giant Neotropical Toad, much of it to be found in the agricultural journals of tropical countries.

Where air temperatures are sufficiently high and rainfall adequate, the toads reproduce throughout the year. In other localities, the breeding season usually coincides with the rainy season. When breeding, the sexes congregate in pools of quiet water. The eggs, numbering as high as 10,000 per female, are laid in long, ropelike, gelatinous masses in the water. In two to four days, depending on the temperature of the water, the eggs hatch, and a small black tadpole emerges. The time required for development in the tadpole stage varies considerably from place to place, depending upon the temperature of the water, the amount and type of food available, the amount of light, and probably the number of tadpoles present. The shortest tadpole stage seems to occur in Fiji, where it lasts from 23 to 24 days. In the Hawaiian Islands, the tadpole stage was found to average about 30 days in the wild, but it was shortened to 25 days when the tadpoles were reared in a hatchery and fed a diet of specially prepared food. In Puerto Rico, a tadpole stage of two



*Photo by C. M. Breder, Jr.*

▲ THE GIANT NEOTROPICAL TOAD is big enough to fill a man's hat and is probably the world's largest toad. Its appetite for insects has saved sugar planters and others untold sums

months has been reported. The normal food of the tadpoles during development consists of algae and the minute animals and plants associated with it.

When the development of the tadpole is completed, the animal transforms from an aquatic, streamlined form into a small toad measuring only about one-quarter of an inch in length. It remains in the vicinity of the water for several days, eating small ants and other tiny insects. After a brief period of adjustment to the new mode of living, the small toad may wander a considerable distance from any water and not return again except to perform the nuptial rites required of a mature individual. Growth is rapid following transformation, and within three months the toad may reach a length of two and one-half to three inches. Sexual maturity is attained at a size of four to six inches, when the toad is about one year old.

When man has introduced the

Giant Toad to assist him in his fight against his insect enemies, he has usually been sufficiently interested in his ally's welfare to assist and protect it during the hazardous period of early development. To do this, he has established hatcheries for the rearing of the tadpoles and has even tried to get the adult toads to breed within the confines of specially constructed enclosures. Up to the present time, no large scale success has been achieved in getting the toads to lay their eggs in captivity. Therefore, the newly laid eggs are usually collected from breeding sites in the wild and brought into the hatcheries. The eggs are placed in large containers of water until they hatch, and the tadpoles are then removed and placed in large pans sunk into the ground. A steady flow of water through the pans is necessary. Here the tadpoles are fed on an artificial diet of mixed food until they transform into young toads and leave the water. The newly transformed

toads are placed in large pens and fed on a diet of small ants.

The Hawaiian Sugar Planters' Association distributes the young toads when they are several days old. They are packed for transportation in moist excelsior or moss, in a strong container that will not crush in transit, and shipped by mail to various parts of the islands. In the Fiji Islands, the tadpoles, rather than the young toads, are usually transported to the desired localities, a method that reduces the cost of rearing them to the toadlet stage but probably involves greater losses among the tadpoles introduced.

Of course, climatic factors limit the geographical extent of the toad's

usefulness. Sometime prior to 1944, the United States Sugar Corporation introduced some of these toads to Clewiston, Florida, from Puerto Rico. This experiment was unsuccessful, apparently because they were unable to withstand the cold. Just what the latitudinal limits are I have been unable to ascertain, but a creature adapted to a tropical or subtropical environment like the Giant Neotropical Toad cannot be expected to thrive in northerly regions.

In recent years all of the new introductions of the toad have been for the purpose of controlling insect pests, primarily those of sugar cane. However, this toad was originally

shipped abroad for quite a different reason. The renowned naturalist, Philip Henry Gosse, tells us that the Giant Toad was introduced into Jamaica in 1844 for the purpose of destroying rats. The Jamaican stock was obtained from Barbados, where the species had attained quite a reputation among the planters for destroying young rats.

The toad is no specialist in its feeding habits. It has a ravenous appetite and will attempt to gulp down any moving object not too large for it to cope with. Sometimes its appetite gets the better of it and it seizes an animal too large to swallow, only to have to release it after a futile struggle. The toad's diet includes, in addition to insects, such animals as snails, slugs, scorpions, spiders, millipedes, centipedes, earthworms, and even small vertebrate animals. However, insects are the principal source of its sustenance. If an abundant supply of insects is available, the toad will stop eating only when gorged to the point of distending its body.

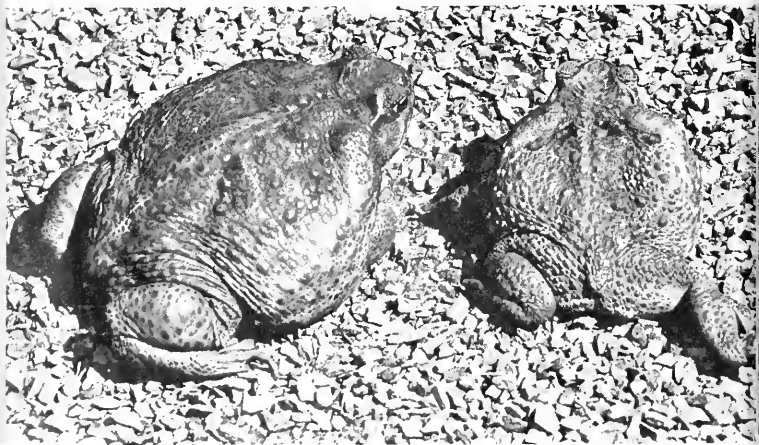
The toad sets forth in search of its food after sundown. Several individuals may gather where insects are numerous, and often they will return regularly to the same location. In Mexico I have seen a number of these toads congregating night after night to devour the many insects attracted to a street light. Any insect that can be caught is eligible for consumption. The animal makes no distinction, of course, between those that are



Photo courtesy C. E. Pemberton and The Hawaiian Planters' Record

A HATCHERY in Hawaii, where toads are hatched for distribution in needy areas

THOUGH UNLOVELY in appearance, *Bufo marinus* has proved itself a boon to humanity and should be allowed to live its life undisturbed



beneficial and those that may be harmful to man's interests, but the vast majority of the food found in toad stomachs consists of destructive insects. Thus the toad's services are eagerly sought by planters and entomologists concerned with the control of pest species. Possibly the preponderance of harmful insects in the toad's diet is due to their greater local abundance or greater accessibility.

There are, of course, exceptions to the good services performed by the toads. For example, where bee-hives are placed only a few inches off the ground, the toads quickly recognize an easily available source of food and congregate in large numbers to gulp down the bees as they alight to enter the hive. The stings of the bees do not seem to deter them at all. The bees can be protected by raising the hives several feet above the ground or by placing a low wire fence around them. Other objections have been raised from time to time against the importation of the toads, but most of them have vanished when the toad has had opportunity to prove its worth. The noise of a large group of males calling during the breeding season may be a nuisance when it occurs near houses. It is reported that an undesirable evening serenade was effectively silenced in Puerto Rico by placing a low wire fence around all ponds near human habitations, since the males call only when in or near water. Nevertheless, it would be unwise to fence off all ponds, because the toads must have access to water in order to lay their eggs.

When first established in the Hawaiian Islands, the frequent occurrence of these huge toads on the highways during warm, rainy nights constituted a minor driving hazard until people became accustomed to them. Dog lovers offered additional complaints; pet dogs became violently ill and occasionally died after biting a toad. Like their masters, however, the dogs quickly adjusted to the toad and learned that it would cause them no harm if left strictly alone. The illness of the dogs was caused by a highly toxic secretion from two large glands

situated on the skin of the back, just behind the eyes. This secretion protects the toad from many would-be assailants who see the toad as a potential meal.

It should be pointed out that the toxic secretion of the enlarged skin glands is used solely for defense and is secreted only when the toad is seized. The effectiveness of this device is illustrated by an observation made by Dr. Albert P. Blair. He placed a female Giant Toad in a small pond. While it was swimming, a turtle seized it and tried to pull it under water. The toad inflated its body so that it floated high in the water, making the turtle's attack more difficult. The turtle finally succeeded in pulling the toad under. However, the toad soon reappeared on the surface and swam unmolested to shore. The turtle was seen swimming in the opposite direction. Examination of the toad revealed that the gland on the side that the turtle had grabbed was thickly covered with a white secretion, while the gland on the opposite side showed no secretion. Dr. Blair concluded that the secretion alone was responsible for the toad's release.

The toxicity of the glandular secretion caused concern among the poultrymen of Australia when the toad was first introduced into that country. It was feared that chickens might become sick and die from eating the toads or from drinking water with which the toads might have had contact. To determine the validity of these fears, the Australian Government conducted a number of experiments. All fear was removed when one of the chickens in the experiment consumed 142 small toads in an hour's time without showing any visible effects!

I can find no recent testimonials relating to the value of the Giant Toad in controlling rats, as suggested by Gosse's account for Jamaica and Barbados. It is doubtful that the toad regularly preys on rodents. There are, on the other hand, many statements attesting its value in the control of injurious insects. It has been of importance not only in curtailing insects that

affect sugar cane but others as well, and in at least two localities it has proved of value in decreasing the number of undesirable millipedes, snails, and slugs.

For a number of years it was impossible to raise a crop of sweet potatoes in some parts of New Guinea because of the depredations of a cutworm. Only small areas could be cultivated with repeated dusting and hand-picking of the insect larvae. Then the Giant Toad appeared on the scene in February, 1937, and by the end of that year the attacks of the cutworms had ceased on the lawns of residences. The following year an excellent crop of sweet potatoes was produced. Did the presence of the toad really have some bearing on the reduction of the cutworm, or were the two merely coincidental? The finding of 110 cutworms in the stomach of one adult toad leaves little doubt.

In Jamaica, one study revealed that, in addition to a large number of harmful sugar cane pests, the average toad contained about ten destructive banana borers. In the Hawaiian Islands, large numbers of harmful rose beetles and Surinam roaches have been found in the stomachs of the toads. The roach is of serious concern to poultrymen because it is the intermediate host of the eye worm of chickens. Indeed, the list of harmful insects destroyed by this toad is far too long to list here, and its influence is felt far beyond the price of sugar in Hawaii and the yield of potatoes in New Guinea.

Science, with its increasing rate of progress, will undoubtedly provide a more effective and more economical means of curtailing or ending completely the ravages of insect pests on agricultural crops. What does the future hold for the toad that man has carried almost around the world? How will man acknowledge his gratitude for the services of his warty assistant? Let us hope that this large toad will be allowed to wander as a recognized friend and search unmolested for whatever food it can find in the gardens, fields, and uncultivated areas of man's domain.

## HOW BIG IS THE BIGGEST?

RESIDENTS of temperate climates are generally unfamiliar with large seeds. When we plant our garden vegetables, we know that a handful of average-sized vegetable seed should suffice for a row or two. In comparison, a horse-chestnut seed is really something to marvel at, as is shown by their popularity among small boys. Yet the seed of the horse chestnut is a puny thing compared to a coconut, and a coconut in turn is puny, too, when set down beside a Seychelles nut, or coco de mer. For the Seychelles nut is the largest true seed that grows and is to the plant world what an ostrich egg is to the animal world. In short, it is the Goliath of all seeds.

For centuries prior to about 1600, gigantic hard-shelled nuts, two or three times the size of an average coconut, were sometimes found washed up upon the shores of India and other lands bounding the Indian Ocean. These enormous seeds looked like oversized coconuts, yet no one knew their origin other than that they were brought in by the sea, and so in this way the name coco de mer (sea coconut) fell upon them. Such marvelous flotsam was rare and, as was common in those days, its rarity was supposed to give it wonderful virtues.

At first, people were not sure whether the great floating objects were plants, animals, or minerals. Before long, and typical of the times, a number of wild tales had been invented to explain the source of these sea-deposited objects. One had it that the nuts grew on submerged trees near the island of Java. Yarn-spinning sailors reported that on diving to pick these under-sea seeds, the trees would mysteriously disappear. Another story related that in certain parts of the tropical ocean the trees, growing above the surface of the water, harbored a griffin, or vulture-like bird, which was accustomed to fly to the nearest land where it fed, of

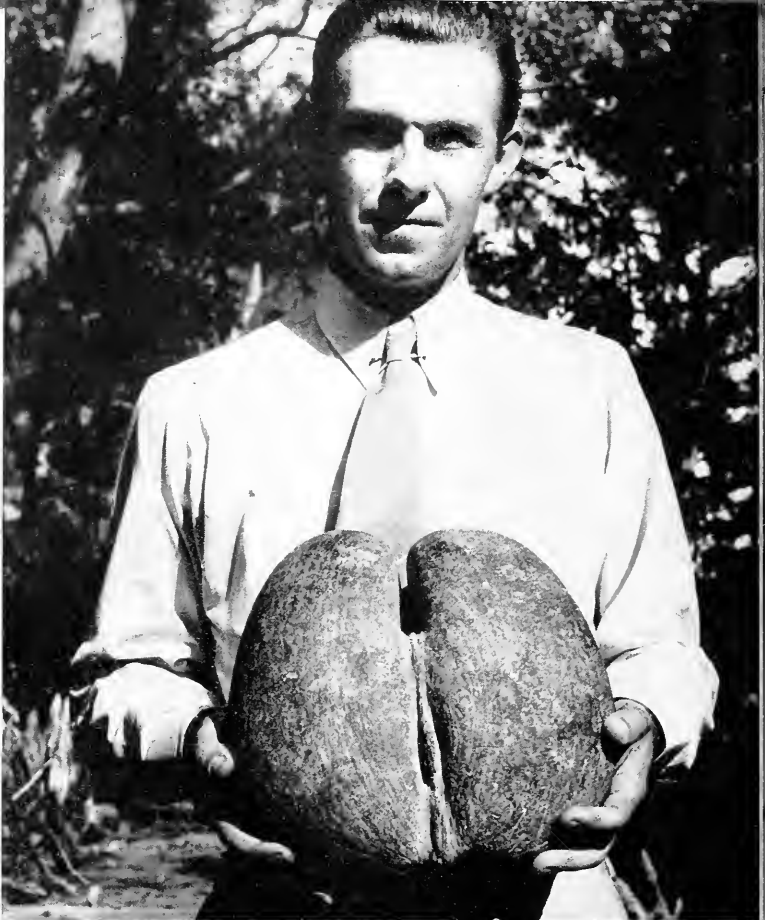


Photo by Hugo Schroder

## The Goliath of Seeds

The largest seed that grows was shrouded in mystery until its island home was finally determined

By WALTER HENRICKS HODGE

all things, on tigers, elephants, and rhinoceroses! Unwary sailors were also devoured by the flying monster if their ships were inadvertently drawn in by the giant waves that, supposedly, surrounded the tree at all times.

Seeds obtainable only after passing such hazards must certainly be as valuable as the mythological golden apples. It is little wonder, then, that kings and other potentates of the Orient coveted the strange nuts and even passed de-

crees that these peculiar objects could be acquired only by persons of high rank. Apparently the nut's chief virtue was as an antidote to poison, and in a day when royalty was under constant threat of poisoning, the possession of a coco de mer was almost a necessity for a successful and continued rule. Obviously, no sum was too large to pay when a charmed life itself could be thus ensured. In those days the nuts must have been hallowed out to form tight receptacles,

for it was believed that poison, however violent, would be ineffective when added to water that had been stored in one of these containers. As the coco de mer became more widely known, it grew in virtue to such a degree that it came to be considered a general panacea, which accounts for the new name, *nux medica*, which was given it in the sixteenth century.

All the aura of mystery that veiled the coco de mer in its early contacts with civilized man was finally lifted in the middle of the eighteenth century. About that time Praslin Island, one of the 29 islands included in the Seychelles group (lying in the Indian Ocean northeast of Madagascar) was discovered, and in its extensive forests of palms was found a curious species of palm (*Lodoicea maldivica*) bearing a giant nut. The source of the coco de mer was at last known.

Despite inroads by agriculturists and curiosity-seekers, groves of *Lodoicea* are still to be seen on this tiny isle of palms. The trees love their own company and form

extensive colonies on the slopes and intervening valleys. Like many another interesting palm, it has wandered at man's behest far from its home, and quite a few distant tropical gardens—a number of them in our own hemisphere—can boast living specimens of this famous species.

The Seychelles nut palm is over-sized not only in its seed but in most other respects. The straight, tough trunk, said to be "as upright and unyielding as an iron pillar," sometimes attains a height of 90 feet and bears at its summit giant, rigid, fan-shaped leaves that often measure 25 feet from the tip to the base of the leaf stalk. A peculiarity of the palm is a queer protective, socket-like bowl into which the bulbous base of the trunk snugly fits. As tough as the hard shell of the nut and apparently made of the same substance, the curious bowl is extremely resistant to decay, and half a century or more after one of these palms has been cut down, its socket may be found perfect in every respect.

◀ THE HUGE Seychelles nut resembles a coconut in some ways. But it weighs upwards of 40 pounds, and its "meat" becomes as hard as vegetable ivory

▼ SECTION through a dehusked Seychelles nut, showing the peculiar two-lobed design

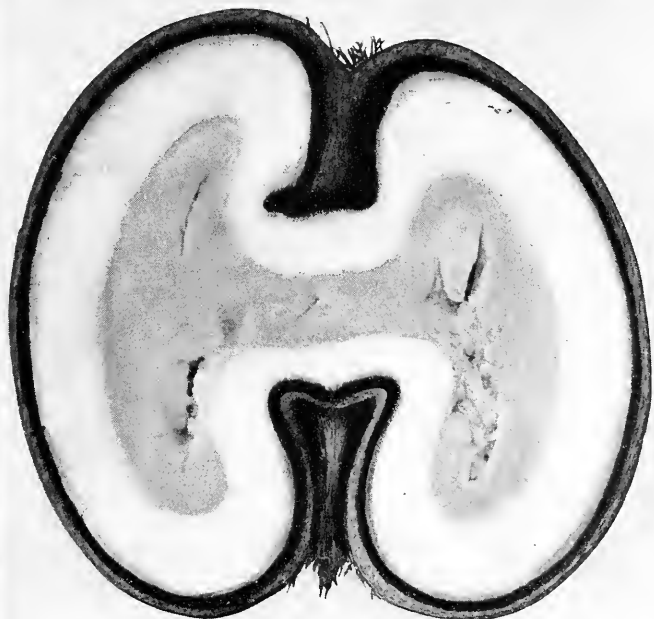


Photo by L. H. Bailey

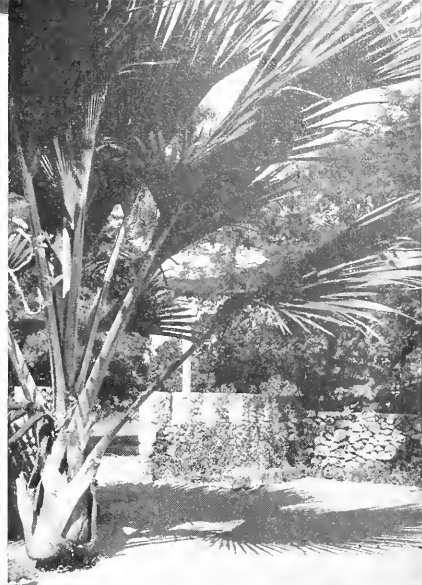


Photo by L. H. Bailey

▲ YOUNG at 40 years: a male Seychelles nut tree growing in Jamaica. It is not yet old enough to have a true trunk

But today, as in the past, it is the fruit that is the most spectacular feature of *Lodoicea*. In its homeland a female palm usually attains an age of at least 30 years before it produces its first crop of nuts, and even then the tree is hardly out of its youth and may not yet possess a true trunk. Clusters of the great nuts, which require about five years to mature, resemble somewhat the common coconut in all except size (a single coco de mer may weigh upwards of forty pounds!), for they have a similar smooth, tough outer coat or husk which overlies the same sort of fibrous layer that one associates with the coconut bought at the corner market. The big difference lies under the smooth outer husk, for the giant Seychelles nut is, unlike a coconut, bilobed, a fact accounting for the misnomer "double coconut" often met with in discussions of this palm. In its youth the jelly-like interior, or endosperm, is edible like that of a green coconut, but at maturity most of it is as hard as vegetable ivory. The edibility of this bizarre nut may thus be transient but not its fame, which firmly rests on its size, making it the Goliath of all seeds.

THERE is a light of earthly origin that fades before the sun or the moon and is neither fire nor heat. It shines only in living moisture. It is the cold light of life itself, no warmer than the organism that produces it, whether in the heavy warmth of a tropical night or the icy cold of the oceanic abyss. It is a light of elfin quality akin to starlight, shining where or when no other light is seen, shining in answer to its own kind, a response of life to life.

The flashing of the firefly and the unearthly halo of the glowworm have excited the ancients and inspired the poets. Tennyson likens the rising of stars to the glitter of fireflies, while Shelley in his immortal ode to the skylark, compares its song to "a glow-worm golden in its dell of dew, scattering unbidden its aerial hue."

Enshrined in literature, the luminescence of animals and plants has also engrossed naturalists for the

# Living Lamps

The mystery of the firefly is but one facet of an astonishing spectacle to be observed in widely varying forms throughout the plant and animal kingdom



By N. J. BERRILL  
McGill University



last two centuries and at the present is the subject of intensive physiological and biochemical research. In the last few decades nearly 500 scientific papers have been published concerning this phenomenon, more than 90 of which have come alone from, or in collaboration with, one man, E. Newton Harvey, whose book *Living Light* is an inspiration to contemporary biologists.

Apart from the aesthetic quality of this eerie light and the emotional response it evokes in the human mind, there is great scientific interest in it, on various levels of inquiry. There is the question of the chemical nature of the reaction that creates the light, a reaction that appears to be essentially the same wherever it is found. There is also the physiological control of the light by the animal endowed with it, and the elaborate structure that is sometimes evolved. The use that the animal makes of it offers some puzzling questions. And finally there is the riddle of why it should be found so widely scattered among distantly related animals and plants, whose closest relatives are often limited to a dull, sparkless life.

Light of living origin is known in virtually all groups of the animal kingdom and, in addition, among fungi and bacteria. Its widespread but sporadic occurrence suggests that the basic chemistry involved is closely associated with the normal activities of all living cells and that all living tissue, when not too specialized, has been and may still be on the point of making this discovery.

The greatest abundance of living light comes from microscopic organisms. Probably every voyager on

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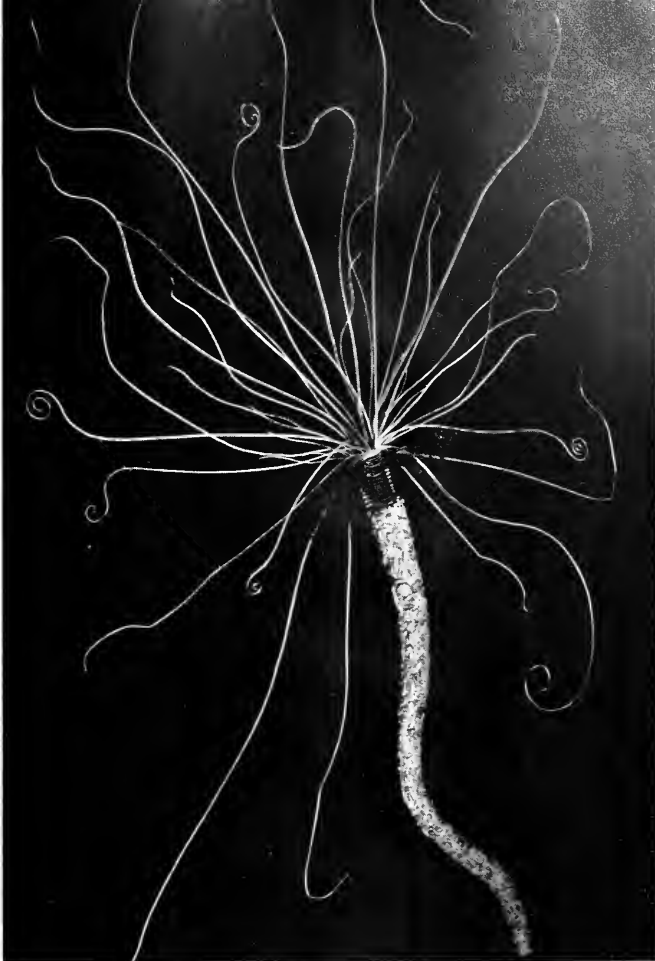
◀ FAMILIAR TO MANY is the luminescence seen in the wake of a ship or in breaking waves. Less familiar is the tiny protozoan *Ceratium*, one of the organisms producing this light. This is a highly enlarged glass model of the creature, painstakingly constructed from microscopic studies



the high seas has at some time wondered and marveled at the phosphorescent wake of a ship on summer nights when the moon is down. This is due for the most part to the so-called armored flagellates—single-celled animals abounding in the upper layers of the seas. They range in size from *Noctiluca* itself, the largest and just visible to the naked eye, to minute forms one-fiftieth of a millimeter across. Many are colored, often pink, and they may occur in such numbers as to make the sea a soup. The reddish color of the Red Sea is due to these organisms; and one of the smaller forms is responsible for the famous Fire Lake at Nassau, in the Bahamas. At night, those that are luminescent will shine when agitated, whether the disturbance be due to the hull of a ship, the passage of fishes, or the breaking of waves. Sometimes shining footprints may be left in damp sand at the edge of the receding tide by a wanderer in the dark. More closely examined, the light is seen to be made up of pin points, each corresponding to a single minute organism. A jar of sea water shaken at night may scintillate from many small flashes. Almost any kind of stimulation, in fact, causes a flash of light to spread over the little *Noctiluca* from two stationary spots, lighting the animal up momentarily and then going out.

A large part of living light comes, however, from luminous bacteria, and it has been found that many organisms do not have luminous tissues of their own but rather gain their luminosity from associated bacteria. The light from a single bacterium cannot be seen, it is so small, but when many of them are present they produce the glow that is sometimes seen on the body of a dead sea animal. They can easily be propagated artificially, emulsions of them giving off light, often bright enough to read by, as long as they have access to oxygen. They have even been cooled to the temperature of liquid air without losing their capacity to luminesce upon being warmed again.

The legendary fox fire of medieval England and older times is due



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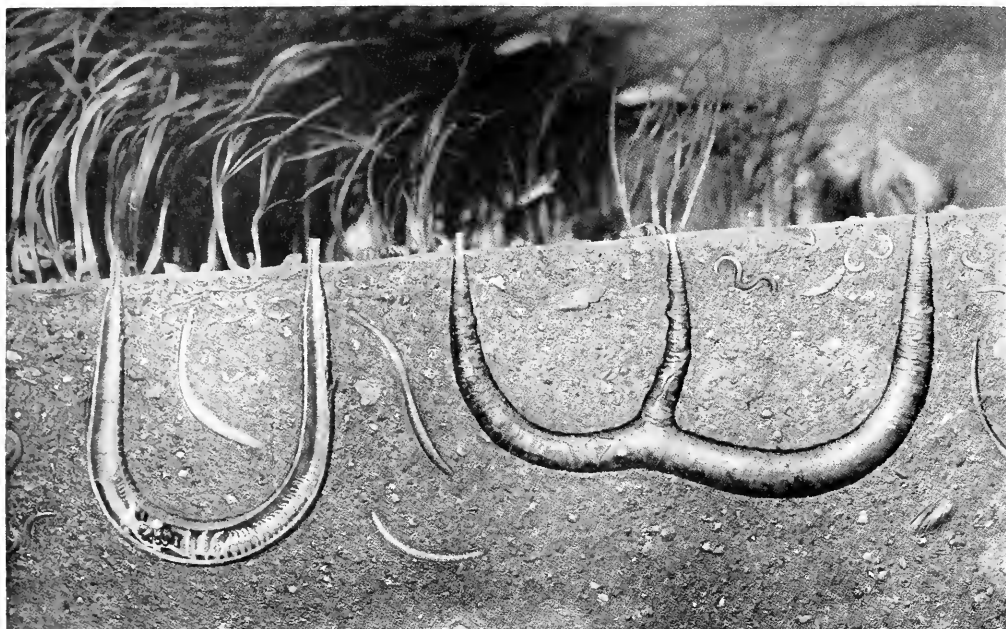
▲ A LUMINESCENT TUBE-BUILDING WORM [*Polynnia (Terebella) magnifica*] from the Bahamas. The body of the worm lies encased, while the long, fine tentacles form a trap for small animals upon which the worm feeds

to luminescent fungi, molds infecting rotting wood and leaves. They are common on the wooden supports in coal mines. In both fungi and bacteria the production of light is continuous and independent of any external stimulation, unlike the flashing or intermittent light of animals.

Luminescence is widespread among the coelenterates, which embrace such diverse forms as jellyfish, anemones, corals, hydroids, and others. Some of these glow more beautifully than perhaps any other creature. Since the time of Pliny, jellyfish or medusae have been known to give off light. One of the most striking is the large Mediter-

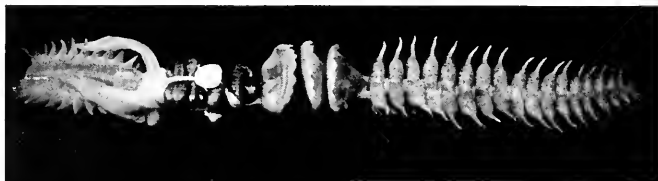
anean *Pelagia noctiluca*, whose name means "luminous swimmer of the night." The larger flashes of light in the sea seen from ships are probably due to such as this. When a part of the jellyfish is touched, a luminous spot appears and may spread until the whole outer surface is involved, including the tentacles. A luminous slime is produced which is liable to stick to a person's hands.

Animals related to jellyfish but having a very different appearance and habits are the sea pens and sea pansies. These are composite or colonial organisms consisting of many individuals united together to form a greater whole and an-



AMNH photos

▲ A WORM THAT HIDES ITS LIGHT: the parchment worm (*Chaetopterus pergamentaceus*). Why a creature that lies completely buried in its tube in the sea bottom should be strongly luminescent remains a riddle



▲ THE PARCHMENT WORM ENLARGED. It lives on tiny food organisms which it propels through the tube by action of the fanlike equipment located in the middle section

chored in the mud on the sea floor by a stalk. The sea pansy of the Atlantic coast has the shape and size of a pansy and shines at night with a clear blue-green or golden-green diffuse light rippling over its surface. Sea pens and a gorgonian sea rod taken from considerable depths often glow with a pale violet light. One of the sea pens, which during the day lies as a tough, turgid mass in the sand on the bottom of fiords in Japan, at night becomes tall and erect and produces a brightly luminous slime from the whole of its outer surface, similar to the jellyfish.

Another group of somewhat lowly sea animals, some of whose members exhibit luminescence to a marked extent, are the marine worms. Light is produced by members of several families. Two of these, the cirratulids and terebellids, are alike in certain ways. In both, the body of the worm lies buried or encased in mud, sand, or crevasses, while long, fine tentacles

writhe over the adjacent sea floor to form a trap for any small animal that may make a false step. Some of these worms, if agitated, send ripples of violet light out from the base along each of the tentacles. Whether this property increases the efficiency of the food trap or is merely a tolerated quality, no one knows.

Even more mysterious is a fantastic worm called *Chaetopterus*. It lives in a parchment tube of its own making, which is for the most part buried but has two open ends projecting a little above the sea floor. The worm lies completely within the tube, its forward region forming a trap for tiny food organisms. The middle region has fanlike equipment for creating a strong current of water, and the

hind part is mainly reproductive. The animal cannot be seen within its tube; it has nothing to gain and much to lose by emerging even to a limited extent, and yet it is strongly luminous. Worms are exceedingly vulnerable, and the luminescence of *Chaetopterus* raises the suspicion that this animal is safely luminous only because it is safely hidden, its light being an ornament to its career and of no useful value.

In the case of the fireworm, *Odontosyllis*, however, there is no doubt that the light is usefully employed. During summer months, in the intervals of complete darkness between sunset and moonrise, the worms rise to the surface to mate. The females reach the surface and liberate eggs, becoming brightly luminescent all over. The males

swim toward the females but exhibit only a slight luminescence at the head end. The males will swim toward any small light at this time, and there is no doubt that the female's brightness serves a purpose.

But among the mollusks we again find the paradox of luminosity that has no conceivable value to its possessor. The rock clam, *Pholas*, is a fairly typical clam common in the Mediterranean. It lives in mud or soft rock and does not move around; it cannot see, and at best it can merely extend its neck or water siphon a little beyond its burrow. It feeds by a continuous inhaling of a current of water, from which the tiniest and most helpless microorganisms are mechanically filtered out as food. Yet the animal is intensely luminous and has a special gland under nervous control for the production of the luminous slime. Is the light merely a tolerated incidental acquisition, or is it employed in some obscure way to aid in the acquisition and sorting of food? Some of the oldest experiments with luminous material from living organisms have been made with this creature. More than two centuries ago it was found that if flour paste or honey were added to the luminous material, it would give light when water was added, even after a year.

Exploitation of luminescence among sea animals has been carried farthest by the two groups that seem to be competitive in most other ways as well—the squids, among the mollusks, and the fishes. Squids and octopuses are fantastic creatures, especially when compared with their molluscan relatives such as the oysters and snails. There is evidence that they possess more than a degree of intelligence and may become afflicted by fear and anger. It is not surprising, then, that the greatest use of living light has been made by those animals that have the better developed eyes and brains. There is a possibility that some squids employ luminous bacteria, but it is more likely that in most cases the light is manufactured by the squid's own tissues. One of the smaller deep-water squids of the Mediterranean, *Heteroteuthis*, which lives in the dark far below the twilight zone, is unique. When a more ordinary squid is disturbed in shallow water, a dark cloud of sepia pigment emerges from its ink sac, forming either a smoke screen or a decoy that enables it to escape its enemies. In the dark depths, such a device could obviously have little value. *Heteroteuthis*, however, while retaining a small ink sac (that it possibly never uses), has evolved a



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▲ THE JEWELFISHES (*myctophids*) flash their luminescence far down in the sea, where the last feeble light merges into blackness

large gland just in front of it, which produces a bright luminous secretion. It shoots this substance out into the surrounding water and envelops itself in a cloud of cold liquid fire.

Other squids are luminous in a very different way. Their light is manufactured in small organs scattered over various parts of the body. A small squid taken in the Indian Ocean at a depth of nearly two miles had, near the eye, jewel-like luminous organs that were ultramarine-blue. In addition it had pearly-white lateral organs, ruby-red ones on the tentacles, and sky-blue lights on the lower part of the body. The light is not extruded as a slime as in so many other forms but is produced within small, closed, spherical organs built somewhat along the lines of a bull's-eye flash-light.

Most deep-sea squids can be obtained only with great difficulty and are consequently very rarely

AMNH photo of drawing by Grace White



▲ THE MARINE FIREWORM, *Odontosyllis*, employs its light usefully. The females become brightly luminescent when they rise to the surface at night to liberate their eggs, and the males are thus attracted to them



AMNH photo

▲ LUMINESCENT LURES at the ends of "fishing rods" contribute to the grotesque appearance of these small Oceanic Anglers

studied. An exception is the firefly squid of Japan, which has been studied alive intensively by a number of Japanese biologists. This squid is caught in immense numbers on the west coast of Japan in the spring and early summer, for use as fertilizer in the rice fields. The luminescence is bluish, but again there are several kinds of organs, variously located. The largest and brightest are on the arms; medium ones are located below the eyes; and minute organs are scattered over the ventral surface. These last differ in the two sexes and possibly serve for sex recognition, since the animals are caught during their breeding migration.

Luminous fishes are perhaps better known than other luminous forms from the sea. Some come from the dark, abyssal waters of the oceans; more are found in moderately deep water in the twilight zone, that region in which there is still a lingering trace of the penetrating surface light. The true deep-sea fishes generally have rows of

luminous organs like those of the squids, the organ itself manufacturing light that shines through a kind of lens. A similar fish that comes in to shallow water to breed is the singing fish of California, which may have nearly 800 light organs along its sides. On the other hand, certain fishes of the East Indies are luminous but are not in any sense deep-sea forms. In these there is a large white organ beneath the eye, which the fish can conceal at times. In one, a black screen of skin is drawn up over the organ to obscure it; in the other, the organ is hinged and can be turned down into a pocket. The reason for these arrangements is that the light itself is not produced by the fish and is not under its control but results from the activity of bacteria contained and growing in the organ. Bacteria produce light continuously, hence the need of a shutter mechanism if the fish is to make good use of it. There is no doubt that the light is used by the fish to attract its prey, and the islanders of the region cut out the

light organ and use it for bait while fishing.

Shrimps and prawns have evolved both kinds of light organs formed in other groups. Some have a gland that produces a luminous slime which the animal can eject. Others have lantern-like organs similar to those of the squids and deep-water fishes. They flash these under control as they migrate more than 1000 feet up and down every day.

Another crustacean, though much smaller, is an ostracod known as *Cypridina* and also as the marine firefly of Japan. It is only about one-eighth of an inch across and is usually caught feeding on fish heads used as bait. Near the mouth the animal has a gland that is very large for its size, and this produces the luminous secretion, bright bluish in color. The main interest in this form is its value in connection with chemical investigations into the nature of the light reaction. When dried, *Cypridina* can be stored almost indefinitely, only to become brilliantly luminous again when wet, even after more than 20 years. The reaction is therefore not essentially a "living" reaction, insofar as it survives the death of the organism. In itself it is not dependent upon living cells, although they are necessary in the stages of preparation. On the other hand, oxygen is necessary, although only a very small amount is essential. In its absence, luminescence ceases. Carbon dioxide apparently is not produced.

Experiments made in the last part of the nineteenth century showed that if a cold-water extract of a luminous tissue is mixed with a cooled hot-water extract after both had been left standing until all light had disappeared, light is again produced. The substance extracted by the hot water and not destroyed by it was called *luciferin*. The substance extracted by the cold water and destroyed by heat was called *luciferase* and was considered to be an enzyme or ferment. When the two are brought together, light results. This concept and these terms are still the basis of present interpretations, even though only 5 out of 21 of the different animals tested by Harvey demonstrated the

luciferin-luciferase reaction. In Cypridina, luciferin and luciferase occur as granules in long, separate gland cells opening at pores near the mouth, and they come together only upon extrusion from the gland as a whole.

The nature of luciferin and luciferase and of their mutual reaction is now the subject of biochemical research, already at an advanced and complex stage. There are, however, some facts of general interest. One part of Cypridina luciferin in 40 billion parts of water can luminesce sufficiently for the human eye to detect. Luciferin has a small molecule and is not a protein. At the same time, there is a specificity that is usually associated with protein nature. Only when the luciferin and luciferase of closely related forms are mixed together does luminescence occur. Extracts from Cypridina, for example, give no light when mixed with those from fireflies. Extracts from different fireflies, however, do produce light when mixed. This last is of considerable interest, for the firefly Photinus has a reddish light, while Photuris has a yellowish one. Combination experiments with extracts have shown that the color in either case comes from the animal supplying the luciferase or enzyme and not from the luciferin, indicating that the light actually comes from the enzyme molecules.

Cypridina and luminous bacteria have been used in most of the modern work on the chemistry and physics of living light. However, luminous insects have been employed for the most part in physiological studies dealing with the nature of the tissues, organs, and general mechanisms involved in the production and control of light by the animal as a whole.

Many insects are luminous, though they mostly belong to two or three orders. The famous glowworm of certain New Zealand caves\* is the larva of a fly that spins a glutinous web. The glowworm of English poetry is a wingless female beetle that shines in summer nights from grassy tufts or hedgerows. The light from the lower

hind part of its abdomen serves to attract males flying in the neighborhood. The Cucujo beetle of the West Indies and tropical America is even more spectacular and has been known for centuries. The adult has a pair of bright, greenish, luminous organs on the thorax and a more orange organ at the base of the abdomen on the underside, only seen when in flight. The light has been estimated as the equivalent of the brightest stars. In earlier times, natives were said to use them as candles and to collect them in large numbers in midsummer to tie to garments as ornaments during the nocturnal festivities. Girls are supposed to have tied them to their feet to illuminate the forest paths in the dark tropical night.

The railroad worm of South America, much rarer, is a beetle larva about two inches long that has astonished everyone who has seen it. It has a red light on the head and rows of greenish lights on the sides of the body which glow continuously for weeks, possibly throughout the life of the larva.

Finally, there are the fireflies (beetles belonging to the family Lampyridae)—the dancing lights of warm nights known almost the world over. Most of them are tropical, although among temperate countries North America and Japan are fortunately endowed. In Japan firefly festivals are held, the insects being bred for the purpose. Not only in the tropics but also here in the United States, many persons have seen firefly displays in which the switching on and off of the lights was synchronized throughout a colony of flies. This is one of the most spectacular sights in Siam among the trees along the river banks. The fireflies fly out of the forest at dusk and congregate around certain favored trees, to flash in close and rapid rhythm for weeks or even months at a time. All those flashing in unison are males, and the phenomenon appears to have no connection with mating.

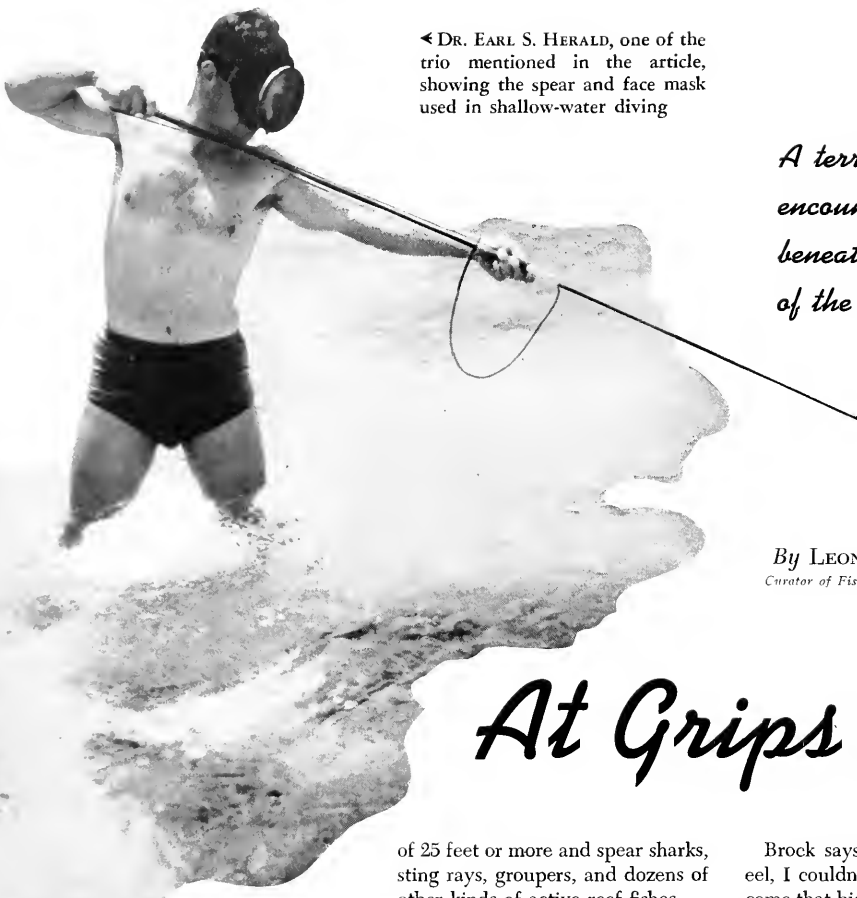
As generally seen, however, the flashing of fireflies is a system of communication that females, usually at rest in the grass, carry on

with males in flight. The male flashes, the female answers, the male flashes again in response, until the pair comes together. Every kind of firefly has its own peculiarities of flashing, which vary in color, brightness, duration, and frequency. An expert can recognize these and so identify the kind of firefly. Normally there are four types of light production: (1) a continuous glow, rare among fireflies, (2) an intermittent glow that remains relatively steady for a matter of seconds or minutes, more characteristic of larval fireflies than adults, (3) a pulsation, given off so rapidly as to produce the effect of a continuous fluctuating light, though usually with occasional periods of darkness, and (4) best known of all, the flash. This is essentially a burst of light, much brighter and shorter than occurs during a glow. Most flashing fireflies give single flashes; but certain forms produce multiple flashes which approximate the flicker-appreciation limit of the human eye.

How the firefly controls the frequency and quality of light is a problem that has attracted much attention, effort, and discussion. Several theories have been put forward, all based on an intimate knowledge of the details of structure and function of these organisms. The light organs themselves are relatively complex, differing considerably among the various species and often different even in the male, female, and larva of the same species. In fireflies and glowworms generally, however, the organ is basically comparable in structure to those of shrimps, squids, and fishes. It consists of a mass of light-producing tissue, backed on its inward side by a reflector pigment layer and covered on its outward side either by a transparent window or a layer of transparent tissue shaped to form a lens.

All in all, the very existence of living light, together with its varied and beautiful manifestations throughout the living kingdom, presents one of the most fascinating phases of the whole evolutionary epic, and it is one that will have appeal as long as there are people to observe it.

\* See "Stars of Death," by Alton L. Blakeslee, NATURAL HISTORY, February, 1948.



◀ DR. EARL S. HERALD, one of the trio mentioned in the article, showing the spear and face mask used in shallow-water diving

*A terrifying  
encounter  
beneath the waters  
of the Pacific*

By LEONARD P. SCHULTZ  
*Curator of Fishes, Smithsonian Institution*

## At Grips with a

of 25 feet or more and spear sharks, sting rays, groupers, and dozens of other kinds of active reef fishes.

Their equipment was simple—swim fins or flippers on the feet, face mask for seeing under water, a six-foot steel rod barbed at one end as a spear, and a rubber sling for shooting it.

### *Almost a One-way Dive*

I will tell you of one daring feat by Mr. Brock that ended in near tragedy. On May 20, 1948, he visited Johnston Island, some 700 miles southwest of the Island of Hawaii. By motor launch he went to the northern reef, where deep channels and pools occur among the beautifully colored algae and coral reefs. Some 50 yards from the boat, he saw a large brown eel partly concealed beneath a coral ledge. Its body was 18 to 20 inches high and 12 to 14 inches thick. The length exceeded all known records of eel size—about 10 feet.

Brock says, "Once I spotted the eel, I couldn't believe it; eels don't come that big. I called over another [man] . . . to take a look. He also didn't believe it. I borrowed his spear and, diving down (the eel was about 20 feet deep), put the spear squarely through the head. The eel did not even move. I left the spot for the surface to observe the eel. Fifteen or twenty minutes passed. I returned to the eel, and in the interval mentioned no movement had occurred. Then I made a little error; I assumed that the eel was dead. I dove, picked up the spear with the transfixed eel, and returned to the surface. The eel began to move. It started directly for me. I attempted to hold it off with the spear, but the eel simply swam up to me, the spear sliding farther out the other side of the body as the eel approached. I dropped the spear and swam off by flippers at a good clip. Swimming on my back, I watched the eel come

**S**KIN diving and the spearing of fishes for sport is a thrilling but sometimes dangerous occupation. Even to the most experienced swimmers and ichthyologists, who know the habits of vicious fishes, accidents happen.

During the long months at Bikini waiting for the atomic bombs to explode, Vernon Brock, Earl S. Herald, and I spent a great amount of time studying the ways of fishes. Vernon Brock is Director of the Division of Fish and Game in Hawaii, and Dr. Herald is Director of the Aquarium of the California Academy of Sciences in San Francisco. Both men are excellent swimmers and could easily swim to depths



at me with great flapping. My head seemed to be the selected point of attack, for I felt the muscular body undulate savagely against mine, first at my feet, then along the right leg, then my hip and side. The eel was almost up to my face. Its tail was well beyond the tips of my flippers. I began to realize that I wanted very much to be elsewhere."

Then the eel reared high out of the water and struck downward as a snake strikes. Its mouth was a foot long, and its teeth from an inch to an inch and a half long. As it struck to engulf Brock's head, he raised his elbow to shield his face. He said, "I felt the mouth tighten convulsively on my arm. The arm felt just like an orange in an orange squeezer—crushed."

After the single bite, the eel opened its mouth and Brock's arm came free. Bleeding profusely, he then swam the 50 yards to the boat,

where a tourniquet was placed on his arm. A navy doctor spent the next two and one-half hours sewing up the wounds. Then Brock was flown in a B-17 to Honolulu for further treatment, at Tripler Hospital. Three months later he had regained nearly full use of the arm, but large scars remained.

The giant eel was not recovered.

### *Unusually Large*

I have seen but one such large eel. That was in 1939 at Canton Island, in the Phoenix group. I had treated a lagoon coral reef with powdered cubé root, along the edge of 20-foot-deep water. Many small fishes were made ill by the chemical, which had reached the bottom. Suddenly there appeared about 50 feet from me a giant brown eel, swimming at the surface in a circle, opening and closing its nearly foot-long jaws, which were equipped

with fanglike teeth. It reared up and out of the water, thus splashing again and again. The massive body was as large in diameter as my leg near the thigh. Its length was close to seven feet. Experience in the capture of many smaller ones had taught me the vicious nature of these moray eels—their willingness to come out and fight if poked or disturbed—and I considered it the better part of valor to let that eel escape, although I greatly wanted it for a specimen.

My identification of the Canton Island giant brown eel places it as a tropical Pacific species of moray—*Enchelynassa canina*. It is highly probable that the same species or a closely related one of that genus attacked Vernon Brock.

It was only the remarkable underwater skill and speed of swimming, which I have witnessed so often in Mr. Brock, that saved his life.

# *Giant Moray Eel*

▼ THE GIANT BROWN MORAY EEL, *Enchelynassa canina*. Note the savage array of teeth



# TERMITES

## Desert Division of Street Cleaning

Something unexpected to look for  
the next time you visit the desert

By LEWIS WAYNE WALKER

*Photographs by the author and G. E. Kirkpatrick*

ONE of my first impressions of the desert was its extreme cleanliness. At the time, I was fresh from the East where rotting leaf mould and decaying stumps were an integral part of all vegetated regions. These new cactus areas, however, had a dearth of dead or dying branches. Why had the changing seasons not left a profusion of this refuse? Instead, the ground looked as though it had been swept with a brush, and even suitable kindling for a small fire was difficult to procure. True, some of the chollas had

dropped their living slips, and from the shaded undersides tiny roots had penetrated the ground. But what had happened to those that had been slow to take root and had succumbed to the broiling rays of the sun?

A few had no doubt been purposefully removed by pack rats to fortify their dwelling entrances. Perhaps kit foxes, coyotes, and rabbits had "not so purposefully" removed others, when the sharp spines had penetrated skin and gained a free ride of dispersal to other regions. Strong winds and flash floods could have carried off many more, but even windbreaks and dry arroyos did not show accumulations of debris.

Several years later and 300 miles south in Lower California, I uncov-

▼ THE AUTHOR explores the work of termites on the edge of Chapella Dry Lake, in California





TERMITES EATING a cholla skeleton. The wood is covered with termite mud

▲ PHOTOGRAPHER G. E. KIRKPATRICK examines the termites' mud houses

▼ TERMITE MUD NESTS cover the flaked areas of a Mexican Cardon tree

ered the first step in the solution of this mystery. My command car had just passed over the dry lake called Chapella and for the first time in three days of travel had been able to jump from ten miles an hour to a speedy sixty. A trail of dust left a two-mile floating wake. Indeed, when some cactus-strewn mountains were climbed, we found that a quantity of this dust had clogged our carburetor, practically preventing the flow of gas.

After the trouble had been remedied, we collected our tools from scattered positions and accidentally brushed one against a brown bough. When touched, the bough disintegrated into small flakes of mud. At ground level there remained a ring of soil about a half-inch in diameter that had walls less than a thirty-second of an inch in thickness.

With this clue to direct our search, we found that termite workings were abundant in the area. Some, like our first find, were just hollow reminders of a cactus that



used to be; others were busy thoroughfares, with the light-shunning insects parading up and down in the channels under the mud.

These cactus-eating termites all seemed to be terrestrial. The aboreal varieties, which can exist without actual contact with the



◀ TERMITES ARE EXPOSED by flaking off the mud walls of their "apartment-houses." Here their dwellings are built on a cardon cactus

▲ A TERMITE WORKER greatly enlarged. Termite society is a highly organized one, with groups of insects having specific duties

ground, were missing. The upper ends of the working mud tubes housed the workers, the industrious members of the complex civilization, while at ground level the soldier or warrior members remained on guard. In the dirt below, there were no doubt yards of tunnels and galleries where one or more queens spent their lives laying eggs and where the larval young were raised to be future workers.

Their menu was varied; it seemed that few if any plants in the region were spurned. Even the dried scales that run up the spine ridges of the giant cardons (Mexican Saguars) were devoured. Some of these large trunks were completely encased with a film of protective mud, while a few were crisscrossed with a beautiful pattern of surface tubes which followed the scale but missed most of the green living tissue.

In other climes there are termites

that are dependent on only a single species of wood. So perhaps these that we saw in Lower California were really many varieties that had happened to settle in the area. The classification of termites, however, is a complex study, not always based on outward appearance of the insect but at times on the tiny living organisms that exist within the body cavity and digest and make palatable the wood pulp eaten by the host.

Several months later I again passed the spot near Chapella and found that the termite workings were a wonder of the past. The area once littered with debris was noticeably cleaner, but the knowledge of "what to look for" has made the discovery of these mud tunnels somewhat commonplace. Now a diligent search in any desert area usually reveals evidence of this Desert Division of Street Cleaning at work.

▼ TERMITE WORK on ocotillo





▲ A WEATHERED IRONWOOD tree with a termite mud shell



# Natural History CRYPTOMAZE

MAMMALS By EDWARD DEMBITZ

**Part I.** In this test you are given a set of definitions, each with a set of blank spaces, and a diagram to be filled in. Each definition is a clue to a word whose letters you are to insert in the blank spaces preceding the definition.

- 12 10 5 17 6 5 *Founder of the Marine Laboratory at Bimini*  
16 13 4 13 19 7 *Pink rose, named after a city in Syria*  
14 18 22 *Evergreen, once widely used for bows*  
7 8 24 12 13 *Marsupial which inspired a toy named after Theodore Roosevelt*  
3 24 5 23 6 25 *American Egyptologist, co-discoverer of Tutankhamen's tomb*  
11 17 21 11 12 13 9 10 *Any of a group consisting of the hoofed mammals*  
19 18 4 15 17 8 12 18 *Indian tribe led by Osceola during war with U. S. troops, 1835-42*  
3 20 6 10 9 24 20 *Carnivore used in Asia and Africa for hunting deer and antelope*  
22 14 13 23 23 18 13 25 2 *Ship used by Lincoln Ellsworth on Antarctic expeditions (2 words)*  
24 3 24 16 1 24 *National Park, Mount Desert Island, Maine*  
9 20 8 5 15 11 4 *Element capable of transmutation by plutonium into fissionable U-233*  
2 15 12 23 16 8 22 17 *An ancient type of man unearthed in England by Charles Dawson*

**Part II.** When you have filled in all the letters above, transfer them to the proper numbers in the boxes in the diagram below.

When the diagram is completed you will have a word maze containing the names of at least TWENTY-THREE WILD MAMMALS. To find one of these mammals, begin with a letter and move from space to adjoining space in any direction, including diagonally, until the name is spelled out.

Copyright 1949  
By Edward Dembitz

	1	2	3	4	5
6		7	8	9	10
11		12	13	14	15
16		17	18	19	20
21	22	23	24	25	

**THREE PRIZES.** The three contestants submitting the largest number of mammals fitting this puzzle will each receive a copy of *Wild Animals of the World*, illustrated by Mary Baker and written by William Bridges. This is an attractive and informative book published recently by the Garden City Publishing Company.

Webster's New International Dictionary—1948 (unabridged) will determine the eligibility of mammals. Any name in bold-faced type in the main section (A-Z) will qualify. One error will disqualify a contestant.

In case of ties, duplicate prizes will be awarded.

Entries must be postmarked on or before January 20, 1949.

Winners and scores will be published in *NATURAL HISTORY Magazine* for March, 1949.

The contest is open to everyone except employees of the American Museum and the Garden City Publishing Company.

done, the man signaled and was released from the cabinet, apparently none the worse for his experience.

The reason this came so close to being the perfect trick, Houdini said, was that there really *was* no trick. The spectator could have done exactly the same thing himself. The steak did not perspire and so it cooked; the man did, and during the short time he was in the cabinet, evaporation of moisture from his skin kept it from getting too hot. The human body's automatic adjustment to abnormal heat, coupled with precise timing on the part of the performer, made the feat possible.

A more recent experiment in heat and its effects on the human body sheds further light on the feat of Chief Terii-Pao and his stout-hearted fire walkers. It was conducted in December, 1947, at the request of the U. S. Army Air Forces Command, under the supervision of Dr. Craig Taylor, physiologist and engineer at the University of California, in Los Angeles.

The Air Corps wanted to know one very important thing: What were the dangers of a jet-plane pilot's being roasted alive in a friction-heated cockpit? These supersonic craft, powered by jet propulsion, need refrigeration systems to keep the cockpits comfortable and bearable. What would happen to the pilot if the cooling equipment failed? Would he collapse at the

controls; would he succumb to heat prostration? Would he have to bail out in the stratosphere or else be literally baked alive in the cockpit? Could he stay at the controls, enduring the terrific heat, until he was able to slow down the plane?

Professor Taylor decided to find out. With the help of assistants, he made a heat chamber from a huge steel cylinder and provided a strong fan to suck in dry air across an outside battery of white-hot electric grids. The first human guinea pigs stayed in the hot-box until the heat passed the boiling point of water (212° F.). These volunteers came out a little groggy and florid-faced but quite "uncooked."

Then Professor Taylor made himself the subject of a most impressive test. His hands, feet, and neck were protected before he was wheeled into the cylinder, the temperature of which had been raised to 230°. He remained in this overheated atmosphere for 15½ minutes, until the heat climbed to 262°. The only effect upon him was that his face became fiery red when the hot blasts of air hit it. Apart from this, he suffered no adverse physical or mental torture.

His answer was simple and to the point: nature has provided the human body with its own cooling system—perspiration. He proved that moisture evaporating from the skin provides parts of the body with a layer of cooler air. A desert water

bag hanging from the rear of a car keeps cool from its own evaporation of moisture through the porous canvas.

Inside the hot-box, Professor Taylor learned that when the temperature was 236°, the air three-fourths of an inch from his nose was 226°. The skin of the nose itself registered a safe 119.5°. Air drawn into the nostrils was cooled down so much that it did not affect the lungs. The general temperature of the body rose only a couple of degrees.

Professor Taylor emphasized that there was danger if the raised temperature was conveyed to the brain cells. This would give pilots of jet planes the surest indication of approaching heat prostration.

He gave this advice. People should realize that the danger from heat is partly emotional. Human beings, whether pilots or persons trapped in burning buildings, can overcome high registers of heat by rational, well organized attitudes of self-preservation. Fear or over-excitement can contribute to an increase in the temperature of the blood.

The fire walkers of Raiatea have had no indoctrination as to the scientific principles of heat. Therefore, they quite understandably look to a supernatural explanation of their safe transit of the fiery *Umu*.

Still, the fire walk is not a bad performance. I think Professor Taylor would find it quite interesting. And Harry Houdini would have to admit, were he alive today, that Chief Terii-Pao, at heart, is not entirely a fraud.

## BOOKS

Continued from page 7

guage, and very simple to use. Thirty of the fifty-two species listed are illustrated by excellent photographs. It is unfortunate that Dr. Smith has chosen to treat as distinct species forms which are probably not even valid subspecies. Thus, he names no less than six species of *Poritis* instead of the two now generally recognized.

The introductory chapters contain an interesting discussion of the distribution and formation of the coral reefs of the world, as well as a more detailed treatment of the western Atlantic reefs. Bearing in mind that Dr. Sheppard's important monograph, *Submarine Geology*, was

in press at the same time as the *Atlantic Reef Corals*, these chapters can be said to present a fair review of the various conflicting theories of coral reef formation. It is somewhat surprising, however, to find that on page 39 credit is given to the Miami Marine Laboratory for discovering reef corals off the west coast of Florida; these have been known for a long time and were shown on Joubin's maps (1912) of the coral reefs of the world.

The remaining chapters discuss the structure, habits, collection, and preparation of corals and give a brief account of the more common animals associated with the corals. An appendix presents a glossary of the principal technical terms used by coral specialists and contains a highly

technical key to all the known genera of western Atlantic corals, including the non-reef building and deep-sea corals as well as the true reef corals.

The chapters on structure, while clearly written, could have been much improved by the inclusion of additional simple diagrams. Perhaps the author intended to do so, as on page 45 there is a reference to a "figure 12" which is not to be found, at least, in my copy.

There appear to be few other misprints, although on page 104 the term "ventriculate" applied to the peritheca of *Acropora* should be "reticulate," and on page 106 the brackets which should enclose the name *Madrepora* have been omitted.

JOHN C. ARMSTRONG.

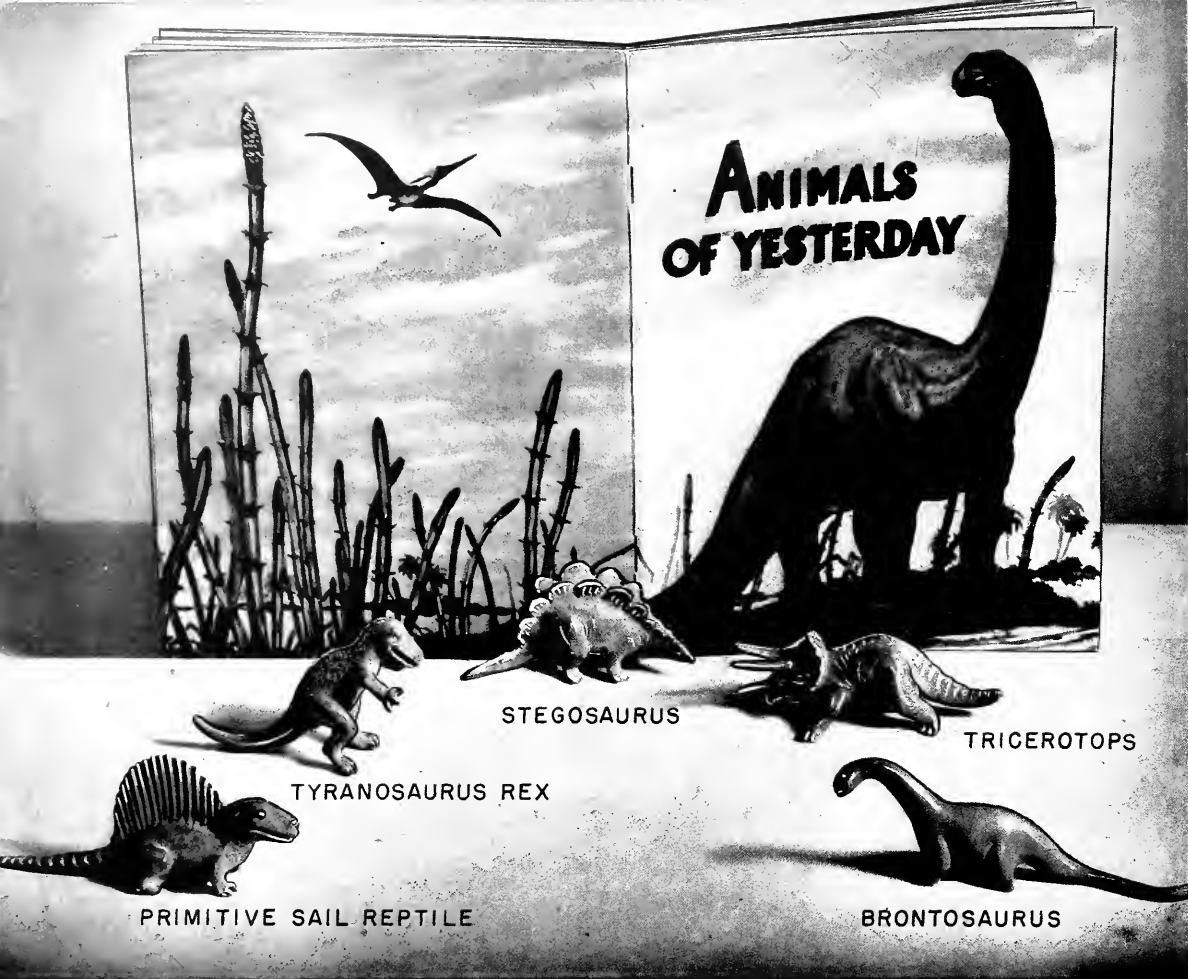




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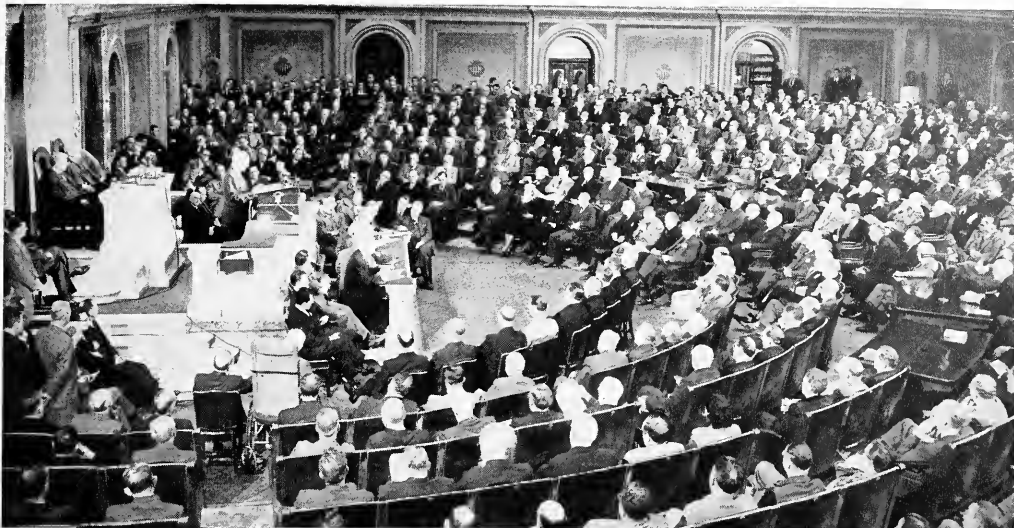
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## Attention Conservationists!

A NEW Congress is in session. Important conservation problems are coming before it. If it is to act wisely, its members will need the advice and active support of every one of their conservation-minded constituents. Many of the members of the Eighty-first Congress are new to these problems, and all are subject to pressure from those who would overexploit publicly-owned resources or invade our precious National Parks and Federal Refuges.

The demand for funds for the many thousands of activities in which the Federal Government is involved always exceeds what Congress has at its disposal to appropriate. Few government bureaus get all that they think they need to properly carry on the work assigned to them. Some, however, get considerably more than others, and if conservation agencies like the National Park Service, the Fish and Wildlife Service, the Forest Service, and the Soil Conservation Service are to be at all adequately financed, interested citizens like yourself who know the value of their work will have to let their Congressmen know how they feel. Congress will receive thousands of letters in favor

of benefit payments and local pork-barrel schemes. If conservation is to get its due, every conservationist—and there are all too few of us—will have to write not one but many letters during the course of the Eighty-first Congress.

Too many conservationists have a tendency to believe that conservation problems can be solved simply by passing legislation that places the problem or the land involved in the hands of some government agency. All this actually does is to make each and every one of us responsible for it year after year. Nothing is accomplished by requiring surveys by the Fish and Wildlife Service of the possible damage to wildlife values that may result from the construction of certain dams if their funds are so inadequate that it will take them ten years just to study the projects already on the drawing boards. Nor is there any use in placing more land under the jurisdiction of the National Park Service if the Service is not going to be provided with an adequate budget for its maintenance. The Park Service's present budget is so inadequate that, swamped with land to administer and visitors to supervise, it is often

unable to prevent vandalism and other activities that tend to destroy the very values for which the areas were given national park status.

Your interest in conservation makes you a member of a select, farsighted group of public-spirited citizens. So long as it is as small a group as it is at present, each member bears a great responsibility, for our conservation problems possess an urgency that will not permit long delays in their solution except at a disastrous cost to the nation. If they are to be solved, you and every other conservationist must make it your business to keep posted and to let your representatives in Congress know at frequent intervals how you think they should act on the various issues that are before them. Don't for a minute underestimate the value of your letters and those you can get your friends to write. One letter, even if it is in lead-pencil on an old paper bag, is worth a thousand complaints about what Congress did or didn't do after it has adjourned.

RICHARD H. POUCH,  
Curator of Conservation,  
American Museum of Natural History.

# MUSEUM NOTES



## **Remarkable 12-Rayed Star Ruby**

This unique star ruby was exhibited on loan in the American Museum's Morgan Hall for two weeks in January. It weighs 25.2 carats and is without a flaw. The gem, a deep violet-red in color, is remarkable for the double star that it shows. This star can be explained as the result of the intergrowth of two crystals in the same space, a phenomenon known in mineralogy as "penetration twinning." The two networks are oriented at 30 degrees to each other, so the inclusions that form the star produce, in this stone, two sets of arms, or twelve in place of the usual six.

The stone was recently found in Ceylon and is the first of its kind ever discovered in 3000 years of mining in the rich Ratnapur mines. In its rough state, the stone passed through several hands before it was polished and the remarkable star disclosed. After display in the Museum, it was returned to Ceylon, and it may be shown later in Europe.

## **"Around the World with Dance and Song"**

For the past seven years a unique and fascinating program of ethnic dances, called "Around the World with Dance and Song," has been drawing capacity audiences to the huge auditorium of the American Museum of Natural History. Leading artists and dance groups in picturesque and authentic costumes have transported thousands of delighted dance lovers to faraway lands through colorful dances and music, ranging from the exotic rhythms of the East to the vigorous and exciting arts of the Western World.

Because of the enthusiastic public response to these programs of international cultures, the Museum has arranged its first season of subscription performances of "Around the World with Dance and Song." This new series will include an afternoon program especially adapted to children at 2 P.M. and an evening program for adults, given by the same artists, at 8:30 P.M. The performances

will occur on seven Thursdays from February 10 through May 5, 1949.

Among the featured artists and groups will be the Korean Dance Troupe on February 10 and Dvora Lapson and Company on February 24. The Korean Dance Troupe, the only group of its kind ever to come to America, will present a program titled "Korean Springtime in Dance and Song." The dances of Korea are deeply rooted in Korean culture and are totally unlike anything else in the Orient. Unique, colorful, and engaging, they are as varied and charming as the music and costumes. The program will include one of the ancient farmer's dances, the delightful Doll Dance, a humorous Masked Dance, an enchanting Swing Dance, and a dramatic Korean Drum Dance. Mr. Taik Won Cho, leader of the group, is of royal birth and is one of the leading dancers and choreographers of Korea. He has dedicated his life to bringing a closer understanding between his people and the people of America. He stated recently, "The tides move swiftly. Perhaps you can understand us quickest through our dances and our music."

"Treasury of Hebraic Dance," presented by Dvora Lapson and Company on February 24, will include the beautiful "Queen Sabbath," the "Jewish Wedding Suite," dances based on Jewish folklore, and dances of Israel. Internationally recognized as a pioneer of Jewish dance, Dvora Lapson has created an extensive repertoire of Hebraic dances and mimed episodes, portraying the life and traditions of the Jewish people.

Other programs in the varied series will feature Reginald and Gladys Laubin in "Arts and Dances of the First Americans" on March 10 and the Radischev Russian Folk Dance Group and Polyanka Ensemble in "Festival of Russian Folk Art" on March 24. Lyda Alma and Yianni Fleury will interpret "Greece in Dance" on April 7, and on April 21 "Traditional Haitian Rhythms" will be performed by Josephine Premice and Jean Leon Destine and Group. In the final recital of the series, La Meri, assisted by her Company, with Juana, will present the exotic dances of various countries of the Old and New World that she has visited.

Further information and tickets can be procured from Hazel Lockwood Muller, Department of Education, American Museum of Natural History.

## **Expedition Returns from Australia**

The first major American expedition to the remote Cape York Peninsula in Australia returned to the American Museum of Natural History in December after

*Continued on page 52*

NATURAL HISTORY, FEBRUARY, 1949

# NATURAL HISTORY

*The Magazine of the American Museum of Natural History*

F. TRUBEE DAVISON, President

WAYNE M. FAUNCE, Vice-Director  
In charge of Publications

ALBERT E. PARR, Director

VOLUME LVIII—No. 2

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## THE COVER THIS MONTH

The quaint Guatemalan village of San Antonio Aguas Calientes, situated at the feet of the volcanoes named Fuego ("Fire") and Agua ("Water"), is well known for its *huipiles* (blouses) and *tzutes* (kerchiefs or serviettes), like those worn by this native girl. Specific designs pertain to the town, and a girl of thirteen must know these and be a capable weaver before she is qualified for marriage.

The spare time of many months is required for weaving such a huipil on a narrow stick or belt hand loom. The brocade patterns of brilliant colors are generally "floated," appearing on the outside only. On the reverse side, which is plain dark blue, an occasional band of the design is carried through as evidence of the rich workmanship on the outside. For ordinary use the huipil is worn reverse side out, and the right side is equivalent to a party dress.

The tzute is an all-purpose cloth serving as protection against the sun, a cover for baskets carried on the head, or as a carry-all. It is a distinctive type of brocade in Soumak and weaving similar to double-running technique in embroidery. It generally is 30 by 40 inches, with all edges selvaged. Designs of birds, animals, and flowers over the geometric motifs lend charm to the soft, finely woven pieces.

MARGARET ROBERTSON SMITH.

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EDITOR: Edward M. Weyer, Jr.  
Elizabeth Downes, *Editorial Assistant*.  
Atherlie E. Karp, *Editorial Assistant*.

ART AND PRODUCTION: Robert E. Williamson.  
Jean Bruck, *Assistant in Art and Production*.

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seven months in the field. The 1948 Archbold Cape York Expedition, as it is officially known, brought back extensive and significant collections of mammals, plants, reptiles, and insects. Spiny Anteaters, Spotted Cuscuses, tiny Musk Kangaroos, "Flying Mice" (smallest of the flying phalangers), and the rare Bennett's Tree Climbing Kangaroo are included among the 1500 mammal specimens, which represent more than 50 species. Dr. G. H. H. Tate, Curator in the Museum's Department of Mammals, states that the extensive collections secured, together with existing specimens from Australia, will give the American Museum one of the greatest Australian mammal collections in America.

Interest is shown by layman and scientist alike in the Tree Climbing Kangaroo, two species of which occur in Australia and several in New Guinea. These kangaroos rarely descend to the ground and even probably bring forth their young in the treetops. They feed on a diet of leaves and fruit. Unlike true kangaroos, they do not employ the tail as a jumping aid but rather as a balancer in tree climbing.

The Spiny Anteater is a survivor of an Order of mammals of probably wider distribution in the Mesozoic Era, 60 to 70 million years ago. Like the more widely publicized Platypus, it is an egg layer, but it is equipped with two-colored spines which serve effectively as armor. It is also provided with digging claws on both front and back legs, and its long narrow snout further helps it to burrow.

The expedition brought back the first representative collection of plants from far northern Australia ever to reach this country, according to Leonard J. Brass, expedition leader and botanist. It almost certainly includes a number of entirely new species. The botanical collection becomes the property of the Arnold Arboretum of Harvard University, which helped to finance the expedition. After study and classification by Australian botanists at the Queensland Herbarium, duplicate specimens will be distributed to other institutions in the United States and abroad. A tree that is reported capable of killing a horse—the so-called Stinging Tree—is among the plant forms to receive considerable attention in the press as a result of the expedition. Though one species of the tree is only about 10 or 12 feet high, the Museum scientists readily testified to the extreme pain it is capable of inflicting.

A collection of more than 500 reptiles and amphibians was brought together by Geoffrey M. Tate, who also served as Business Manager of the expedition. These include two specimens of Johnston's fresh-water crocodile, which is new to the Museum's collections, and the Death Adder, a snake that is extremely poisonous though it seldom reaches more

than two feet in length. This snake, however, is not as much feared by the natives as is the seven-foot Taipan, a rare and extremely deadly snake found on Cape York. Among other reptiles are a twelve-foot Carpet Snake, named for its close resemblance to the markings of Oriental rugs, and some five-foot specimens of the big Monitor Lizard, which Australians call Goannas.

In addition, thousands of insects and spiders were brought back.

The expedition, which traveled from end to end of the Cape York Peninsula, a distance of 500 miles in a straight line, is part of a continuing program of field work carried on in the Indo-Australian area by the organization known as Archbold Expeditions. Three previous expeditions had explored New Guinea in furtherance of the program before the war. The Cape York Peninsula and New Guinea provoke special scientific interest because of the probable existence of a former land connection between them. This land bridge formed a two-way traffic route for plants and animals. Most of New Guinea's marsupials (pouched mammals) are of Australian origin. The wallabies, bandicoots, and many birds of southern New Guinea would be familiar to Australians. Most rodents and a great many plants of eastern Australia came down through New Guinea.

In addition to those already mentioned, the expedition included Hobart M. Van Deusen, who assisted in the search for mammals, Mr. Donald Vernon, chief preparator of the Queensland Museum, Mr. Joe McLaughlin, a long-time resident of the Cape York area, and three aboriginals from the Cowal Creek Government Mission, who assisted in the hunting and trapping, as well as in the collecting of plants.

**Many Thanks**

SIRS:

Many thanks for your interest in my letter regarding extra copies of *NATURAL HISTORY* for the sanatorium at Colchester [published in *NATURAL HISTORY* last December] . . . Frankly, my husband thought I was crazy to write, but now I am very glad I did, knowing how much the Magazine will be enjoyed if anyone is good enough to offer a subscription. I still will be glad to help with the postage, if necessary. . . .

MRS. W. BRITAIN.

London, England

*NATURAL HISTORY* is happy to announce that two members of the American Museum have signified their willingness to sponsor a year's subscription to the Magazine in response to Mrs. Britain's inquiry regarding "extra copies."—Ed.



# YOUR NEW BOOKS

CHINA • GEORGE CATLIN • BADGER  
JUNGLE MAN • MACHU PICCHU • CONGO

## CHINA: THE LAND AND THE PEOPLE

----- by Gerald F. Winfield  
William Sloane Associates, \$5.00  
437 pp., 2 maps, 29 photos

THE romantic veil is again lifted from China. What is revealed beneath is enough to make one forget momentarily about silks and teas, about porcelains, jades, and bronzes, perhaps even about opium and bird's-nest soup. Instead of Mandarins dwelling in idyllic "willow-pattern" surroundings, we are made to see the highly honored but toilsome life of the small farmers.

These country folk, numbering fully 80 per cent of a supposed half billion population, together with a sprinkling of officials, scholars, artisans, and laborers living mostly in walled cities, occupy a solid block of territory larger than the Greater United States. China proper, or the Eighteen Provinces, lies exactly within the limits of our own continental latitudes; but, having been partially isolated by natural boundaries, her largely homogeneous peoples and their common culture have necessarily developed along independent lines until today, after nearly 5000 years of either traditional or recorded history, her civilization presents many peculiarly distinct traits. In fact, so set in their own social ways and so delicately adjusted to their natural environment are the Chinese that our sympathetic author believes radical measures are required to help them out of their present relatively static condition.

Specifically, the first half of this timely book describes in considerable detail Chinese agriculture, diet, clothing, and housing as well as health conditions, education, language, and local government. The reader will find here not only many astonishing facts relating to the various deeply integrated aspects characterizing the daily life of a hitherto resourceful and sophisticated nation but also much food for thought. The second half deals constructively with the imperative "rebuilding of China," through general education, sanitation, land reform with accompanying improvement and expansion of agriculture, and the further development of nascent manufacturing industries. The last step is regarded as the only normal way in which to reduce a too dense farm population to the point where higher standards of living become possible all

around. In brief, while China long since achieved, by the so-called old trial-and-error procedures, a cultural status that was doubtless satisfactory for a time, it is now necessary for her to introduce modern scientific methods.

The obvious political implications of these economic and social reforms have no place here. It must suffice merely to indicate the author's opinion that China's future welfare constitutes a "direct challenge to the West," a challenge to be neglected only at our own peril.

NELS C. NELSON.

## JUNGLE MAN

The Autobiography of Major P. J. Pretorius. With a Foreword by Field-Marshal J. C. Smuts  
----- by Major P. J. Pretorius

E. P. Dutton and Company, Inc., \$3.75  
256 pp., 15 ill., 2 maps

ALL too often the ivory hunter was no brave pioneer but a poacher, contemptuous of government. If, in wartime, he became a useful scout, he was redeemed. Such a life story is here related in the first person; and since Field-Marshal Smuts vouches for the scouting, that merit must be accepted.

In some other periods of his career, however, Pretorius seems far less heroic. As a young man in Zambesia, he hunted, traded, and quarreled with natives. Later he sought ivory in German Ruanda and again became involved in battles with

the inhabitants. Small wonder that he was arrested and sent to the coast for trial.

The Prussian heel may have been heavy in East Africa; but after a short prison sentence Pretorius was again permitted to hunt elephants. With profits of \$17,000 in six months, he started a cotton farm on the Rufiji River; but when a new elephant license was refused him, he went over into Mozambique for ivory. Soon the Germans confiscated the farm, and I cannot share his indignation.

Seeking vengeance, Pretorius made successive raids back into German East Africa until he had tusks equaling the farm in value. Then came World War I; shot in both legs, he succeeded nevertheless in reaching Nyasaland. Unfit for military service, he soon was drafted by the Admiralty to locate the cruiser "Königsberg" in the Rufiji Delta. What a chance for revenge; how sweet its realization! Thus began his notable services as a scout.

In 1920, the passion for slaying elephants revived itself. Pretorius was engaged by the Government to reduce the Addo Bush herds. During that ruthless campaign one of my closest friends visited him in his elephant camp. The Major was certainly tough, in every sense of the word! If that be an inspiration, then Heaven help the big game of Africa.

JAMES P. CHAPIN.

## THE NEW NATURALIST—

A Journal of British Natural History  
----- Edited by James Fisher

Collins, 14 St. James's Place, London,  
21 s.

216 pp., 12 color and 175 black-and-white photos

NOTHING could be easier than to introduce the first edition of a new natural history series, especially when it is edited under the leadership of such a competent naturalist as James Fisher.

The *New Naturalist* is a journal of British natural history, published annually, though future numbers will be issued quarterly as soon as it is possible to do so. This edition is not just a first number of a periodical but a special issue complete within itself; and, judging from its merits, succeeding numbers should be of immeasurable value to every nature lover.

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with a view to making the journal popular by substituting fancies for facts. Natural history is a tradition in Britain and is, in fact, a very old one at that. It has been cultivated far longer and with greater zeal than in any other country in the world. There are hundreds of local natural history societies in Britain, with a total membership of over a hundred thousand. The British are not hasty in their selection of literature, but they are sticklers for accuracy. In some of my reviews I have purposely omitted criticism of inaccuracies, especially in illustrations, that might seem appalling to a trained naturalist, but there are no such cardinal errors in this journal.

This first volume is divided into four parts, denoting the four seasons of the year, each section of which embraces a special subject compiled by several competent authors. Thus the Spring Number is entitled "Woodlands," and the Summer one, "The Western Isles of Scotland." The Autumn Number is on Migration, and the Winter one is entitled "The Local Naturalist." The book is lavishly illustrated in color and black and white, and the superb photographs should win top prizes in any photographic contest. The articles were carefully chosen for their quality, scope, and variety.

GEORGE C. GOODWIN.

## PURSUIT OF THE HORIZON

A LIFE OF GEORGE CATLIN

----- by Lloyd Haberland

The Macmillan Co., \$5.00

239 pp., 17 illu.

AN account of the life of George Catlin is timely and valuable since few today are acquainted with the history of this extraordinary man of genius to whom we are deeply indebted. We know a great deal more about our frontier life—Indians and bison—than we would had Catlin not lived.

In reading about this man of vision, of his enormous energy and enthusiasm, of his constructive and discerning mind for man's betterment, I am reminded of Carl Akeley. Unusual minds like these generally encounter difficulty in bringing the great body of the usuals to cooperate with them. As the story of Catlin unfolds, it becomes more and more engrossing. I myself long ago, when advised to remain in Europe where I had studied instead of returning to America, saw the vast and marvelous pictorial opportunities here. Despite the warnings of difficulties with which I would have to cope, my vision brought me back.

## NATURAL HISTORY BOOKS

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"It is dime novel stuff" . . . "It is in artistic" . . . "There is nothing in America to paint." These expressions of blindness and stupidity no doubt were hurled at Catlin, as at me, but they glided off.

Mr. Haberly has shown a deep understanding and insight in his picture of Catlin—a very difficult picture to draw. I cannot escape the conviction that had Catlin concentrated and confined his efforts to our Plains Indians and not merely sketched but composed portrayals of their lives in more intimate and convincing detail, his work would have shamed and silenced the carping Schoolcrafts and their ilk.

It is a thousand pities that this trail blazer, this man who sacrificed everything for an idea—a big and sound idea—did not receive more co-operation from a public for whose benefit he was working.

This is the biggest lesson Mr. Haberly teaches.

WILLIAM R. LEIGH.

## THE NEW CONGO

----- by Tom Marvel

Duell, Sloan and Pearce, \$5.00  
395 pp., 10 maps

TOO many Americans think of the Congo as a land of jungles, fevers, and dangerous beasts. Tom Marvel, after working there for the O. W. I., decided the world should hear rather of the amazing progress made within the span of a single life, since the country was opened by Stanley.

As background he gives a short account of its exploration and pacification, the collaboration of Henry M. Stanley with Leopold II, the founding of the Congo Free State. The abuses charged against the Free State were slight compared with the earlier cruelties of Arab slaves.

After a graphic picture of the geography and the great river system, we are taken on a tour of the great Belgian Congo and Ruanda-Urundi, just as Marvel saw them after World War II. The Congo produces not only copper and tin but gold, tantalum, cobalt, and a large share of the world's industrial diamonds. If you fail to find uranium in the index, just look up radium. Palm oil and cotton form but part of the Congo's vegetable wealth.

It has been claimed that government in the Congo is too paternalistic; that all which is done for natives is designed to increase dividends. But no one can deny the benefits in health, security, and economic progress. The system enabled the Congo to contribute enormously toward victory over totalitarianism.

Some of the newer activities here described are the National Institute of Agronomy, silkworm culture, elephant domestication, and the four National Parks. All through the book, emphasis is placed on the training given to natives

for the varied careers now open to them. If "every prospect pleases," it must be remembered that Tom Marvel set out to show us the bright side, and for this the new Belgian Congo offers vast possibilities.

JAMES P. CHAPIN.

## THE BADGER

----- by Ernest Neal

Published by Collins, 14 St. James's Place,  
London, 12s.6d. net  
155 pp., 30 photos, 12 maps

DESPITE the ever-spreading towns and villages that yearly encroach on the countryside of rural England, there is still a wealth of wildlife to be found that has survived throughout the intervening years from historical times of Robin Hood to the present day. This first book in the monograph series of the "New Naturalist" will stimulate the interest of the general reader in wildlife by recapturing, at least in part, some of the inquiring spirit of the old naturalists. In a study of British fauna there is perhaps no phase more difficult to cover than the life history of the badger. It is strictly a nocturnal creature and the shyest mammal found in Britain.

Ernest Neal not only watched the artful maneuvers of these cautious creatures during the dim light of night, but he took some excellent photographs of them in their native habitat—in pairs, singly, and in groups of four or five adults. In one picture, he even caught both of the parents and two young.

The text itself is a noteworthy contribution to the life history of the badger. Mr. Neal has, with indefatigable patience, solved many of the mysteries surrounding the life cycle of this night prowler, and he has also pointed out many problems still to be worked out.

*The Badger*, like all the "New Naturalist" publications, bears the stamp of scientific accuracy, and in good measure represents the author's many hours of personal observation. The final results of his research, as published in this volume, give a picture of the life cycle of the

badger and its habits throughout the seasons, including its behavior in times of play, defense, and attack.

GEORGE G. GOODWIN.

## LOST CITY OF THE INCAS

----- by Hiram Bingham

Duell, Sloan and Pearce, \$5.00  
263 pp., 60 illu.

THOSE who have been privileged to visit Machu Picchu will never forget it. Those who have not, and hope someday to travel in South America, should include it in their itinerary. This remarkable citadel, constructed by the Incas on an inaccessible mountain crag in the eastern watershed of the Andes, is truly amazing.

Today, as one travels there on the railway from Cuzco, it is hard to realize how inaccessible it was even as recently as 1911 when Hiram Bingham found it. The account of this discovery, well told in the present volume, is a welcome addition to the various scientific reports stemming from Mr. Bingham's six Peruvian expeditions.

Students of Peruvian prehistory will disagree with the author's suggestion that the structures at Machu Picchu antedated by centuries the development of the Inca Empire. His contention is based in part on legends and in part on structural differences in the masonry walls. The objections arise from the fact that all of the pottery recovered, both by Mr. Bingham and by later work, is what might be called Classic Inca. The identical ware occurs in middens on the Peruvian coast and is there datable as from the last half of the fifteenth and the beginning of the sixteenth centuries. As pottery styles and decorations change rather rapidly, it is hardly possible that Machu Picchu is as old as the author implies. This professional difference of opinion, however, in no way detracts from his story.

JUNIUS B. BIRD.

## HENRY A. WARD

MUSEUM BUILDER OF AMERICA

----- by Roswell Ward

The Rochester Historical Society  
Rochester, N. Y.  
297 pp., 12 illu.

THIS biography should prove of keen interest not only to those who have been associated with the American Museum long enough to share in its history but also to the many present-day collectors who have availed themselves of Ward's Natural Science Establishment. From its pages Henry Ward emerges as a uniquely great American of the latter nineteenth century, whose multifarious activities were a byword even in that era of varied careers and miraculous opportunities. His restless energy found its

Continued on page 96

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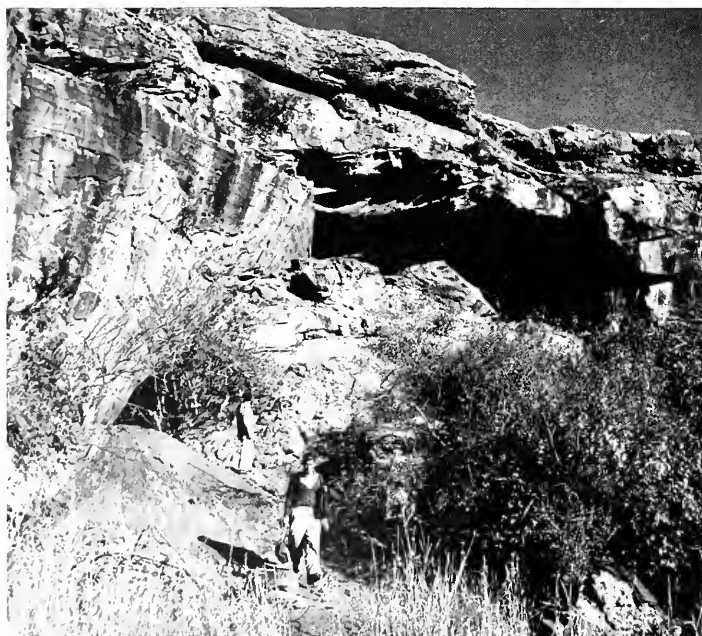
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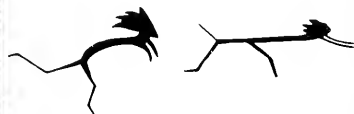
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▲ A COPY OF A BUSHMAN PAINTING in which the central figure is thought to represent a white woman of Mediterranean origin. As described by the Abbé Breuil, her costume is a sweater, and the big cuplike flower she raises to her face recalls the ancient statuettes and frescoes of Knossos, in Crete. The Leopard's Ravine in which the painting is located is in the Namib Desert in extreme southwestern Africa



◀ STUDENT HELPERS in the vicinity of the Paul Loewenstein Cave near Ladybrand, Orange Free State. This cave is the scene of Professor van Riet Lowe's archaeological excavations



ANCIENT

# Bushman Brushwork

The world's largest "picture puzzle" challenges experts on the story of prehistoric man in South Africa

By BETTY AND VICTOR JORGENSEN

*Photographs by Victor Jorgensen from Three Lions*

SOME of the strangest, most fascinating, and yet unstudied pages in the history of man are penciled on the soft sandstone walls of thousands of caves and half-caves throughout the southern part of Africa. These sometimes faint, sometimes brilliant, but always delicate frescoes are the so-called art of the Bushman.

For years archaeologists have probed and sifted the sands of

Egypt, have scraped and mapped the olive-crowned hills of Greece, and have studied and debated the prehistoric paintings in the caves of Andalusia, the Pyrenees, and France. But except for a small group of enthusiasts (so small that in almost 50 years they have done little more than scratch the surface of this tremendous record), there have been few extended studies of Bushman art.

Even the term "Bushman art" is unstudied. Although there is little doubt that a large percentage of the rock paintings still visible were executed by the Little People, as the Bushmen are known, there are

▼ TYPICAL CAVE PAINTING COUNTRY: a scene at the end of the road in Orange Free State. From here it was five miles through upland meadows to Ho Khotso on the Caledon River



other rock paintings that may be the work of some great unknown race who inhabited the cool, sun-swept highlands of southern Africa long before the Bushman arrived.

Yet the Bushman and his art are an unquestionably valuable avenue of research into prehistory, for as recently as 100 years ago, the Bushman was still living in much the same state as man of the Paleolithic age and was still painting in much the same way. His clothes were animal skins, his tools were bits of flaked stone, his paints were out of the ground, and his brushes were from the feathers of birds. There are a few Bushmen still surviving in the scorching wastes of the Kalahari Desert, but they are the scattered, broken remnants of a once-numerous race that held sovereignty over the entire southern end of Africa from the Zambesi to the Cape of Good Hope. So far as is known, none of the surviving Little People paint.

The geographical range of the ancient rock paintings is staggering. These paintings, and the even earlier rock engravings, are found throughout southern Africa from the Rhodesias south—not in single, widely scattered areas as they are

in Europe but in an almost continuous belt that encloses literally thousands of caves and rock shelters, each with many examples of the primitive art. One of the most valuable studies of the art so far has been simply the listing of the various sites where paintings are found, a project originally started by Professor I. Schapera and A. J.

H. Goodwin, of the University of Capetown, in 1925. The first compilation eventually was published in 1936, and the latest edition (1941) includes a listing of 1766 farms on which caves have been located. But this figure is misleading, according to Professor C. van Riet Lowe, Director of the Union of South Africa's Bureau of Archae-



▲ INSIDE THE PAUL LOEWENSTEIN CAVE. Some eighteen feet below the modern level, Philip V. Tobias, research student, works near the beginning of the Early Modderpoort layer. The many implements found in this most ancient level are placed in the early Neolithic Period. The prehistoric natives may have begun painting during this time, but as no examples have been found in the excavations, Prof. van Riet Lowe and his assistant B. D. Malan are skeptical. Above the Modderpoort is a four-foot layer that is culturally poor, then a four-foot layer containing many fine blades and hearths, and finally what is called the Free State Wilton culture



◀ ANOTHER VIEW inside the Paul Loewenstein Cave, showing Philip V. Tobias and B. D. Malan at work. The Early Modderpoort layer is the deepest and richest in implements, but it is only one foot thick







➤ SIFTING THE DUST OF AGES for relics of the Modderpoort culture in the Paul Loewenstein Cave. It is Prof. Lowe's opinion that the cave was first inhabited 10,000 or 15,000 years ago. One painting on the cave wall represents a whale, although the ocean is 200 miles away. But none of the paintings are below the present floor level

▼ SORTING the specimens showing human workmanship. Material from different levels is, of course, kept separate



ology. The actual caves may be two, three, or four times as numerous, since most of the farms contain more than one site. Professor van Riet Lowe and his small staff are still adding to the list.

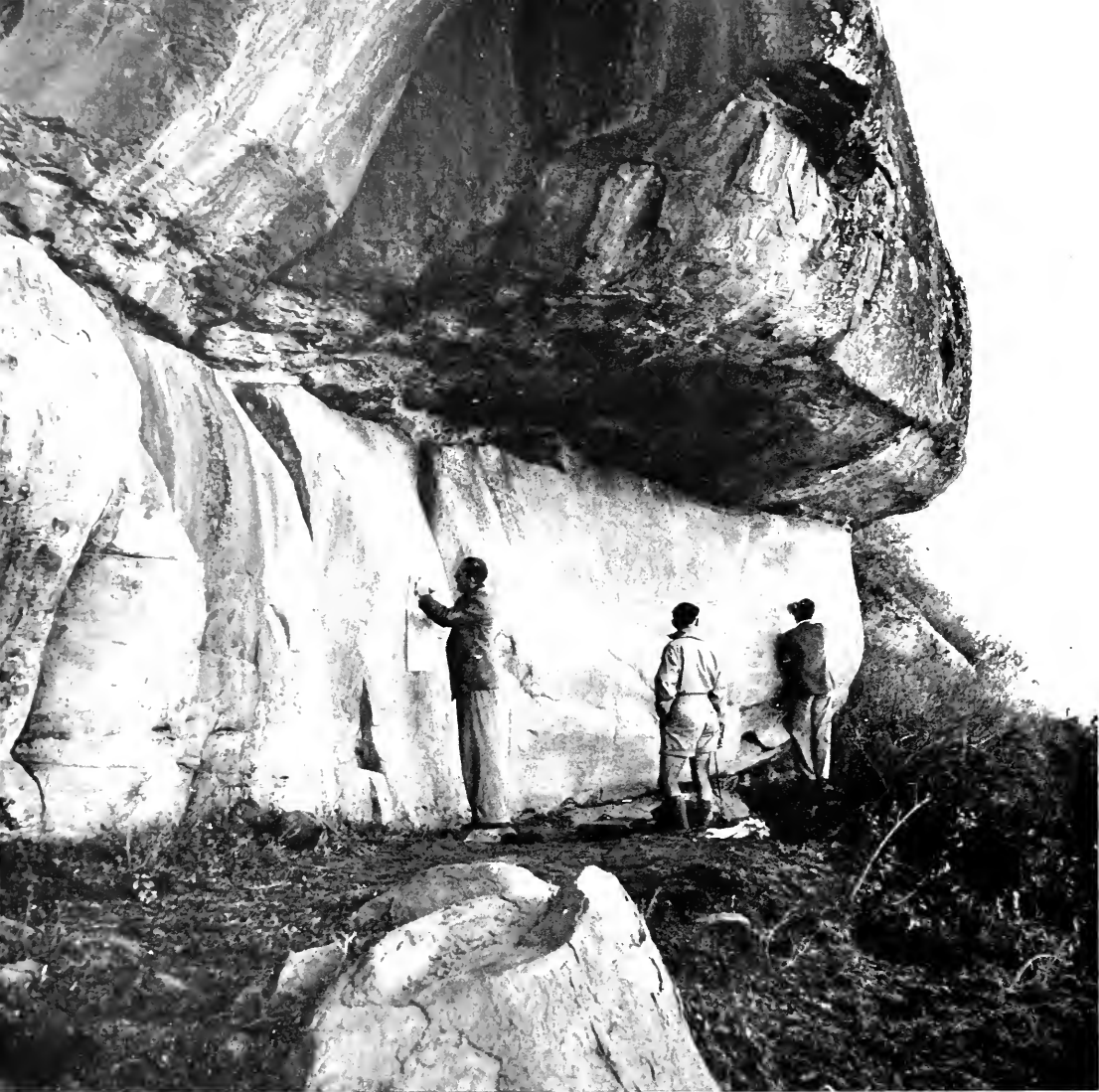
Many of the sites are what are called rock shelters—shallow caves in the face of sandstone outcrops that jut from rolling hillsides. Some of them are no more than a yard or

so deep, while others may extend well back into the rimrocks. Their distribution roughly follows Africa's "Great Escarpment," the edges of the 5000- to 6000-foot plateau that was pushed upward in the geological past. The escarpment is like an immense fishhook whose eye is in Ethiopia and whose shank stretches southward through the highlands of Tanganyika and Kenya to South

Africa, where the curve of the hook follows the edge of the continent around and past the Cape of Good Hope. The barbs of the hook lie in southwest Africa and Angola where the highlands begin to taper down into the damp, torrid basin of the Congo. The greatest known concentration of rock paintings lies along the heel of the hook in South Africa, and it is there, too, that the prehistoric artists left their best works.

The paintings in the caves vary tremendously both in brilliance and number. In some caves there are relatively few, while in others the 40- to 50-foot-long walls may be covered with frescoes so that they look like huge animated panels. A great many of the caves contain paintings that have been done on top of other paintings—palimpsests, to apply the word that is used for manuscripts and tablets showing the work of more than one period. These overlapping paintings are particularly useful to the archaeologist, because they enable him to determine which type of art was the earliest.

In subject matter the paintings cover a wide range and show the prehistoric artist to be quite thorough in representing his surroundings. A great many paintings are of animals—the source of food—and in separate districts the types vary



▲ TRACING CAVE ART in Orange Springs Cave

according to what must have been the distribution of game at the time. The Bushman painted the kudu, elephant, giraffe, rhinoceros, buffalo, eland, sable antelope, zebra, quagga, hippopotamus, leopard, lion, and almost every other known variety of animal in Africa. Bird paintings are occasionally found, and also the portraits of snakes and frogs. Trees and landscapes generally are rare, as are fishes, though in one cave, 200 miles from the Indian Ocean, archaeologists did find a painting of a school of dolphins.

Nor did the rock artists omit humans. In almost all the caves there are big and little drawings of



the people in their daily activities—hunting, at war, occasionally fishing, dancing, and a few that ethnologists believe are portrayals of funeral ceremonies and rain-making rites. Unlike most of the animal pictures, which are drawn with almost photographic fidelity, the human figures are impressionistic enough to satisfy any modernist. The Bushmen, who were notably short in stature, painted themselves as long, slender, and graceful. Some experts believe that the impressionistic portrayals resulted from a compensation psychology, while others

think that the Bushman probably developed this rendition from watching his own shadow dance across the veld of Africa in the waning sun. At any rate, most of the human figures have the conspicuously fat buttocks (*steatopygia*) common to Bushmen, and this is one reason they have been called Bushman paintings. Yet the same characteristic has been noted in the Paleolithic rock paintings of the Pyrenees. This has led some archaeologists to consider the possibility that the Bushmen originated in Europe.

The painted figures themselves are amazingly lithe depictions of people running, dancing, and jumping and are done with the same keen perception of the fundamentals of movement that mark the Bushman's paintings of animals. They are, as the Abbé Henri Breuil, France's noted archaeologist, said, "a sort of moving picture film expressing throughout *joie de vivre*, the delight of being agile, fleet-footed, supple in sport and dance, deft in shooting arrows . . ."

Techniques, too, vary widely, and the studies made so far show a definite continuity in time. That, at least, was the opinion of the Abbé Breuil. The earliest rock paintings were monochromes, or

single-color sketches, generally of animals in simple profile, much like the artwork of a child. From that approach, the prehistoric artists developed the use of two and more colors. At the same time, there was also a definite continuity in their ability to paint, which developed to the point where many of the paintings show an amazing rhythm of line, the already mentioned perception of movement. Finally, we note the beginnings of technical artistry such as foreshortening, perspective, composition, and rudimentary modeling, which are seen in polychromes where the prehistoric artist used shading in different colors.

Many of the paintings even today are still quite bright and clear,

though there are thousands that have faded through the years until they are thin and shadowy. But the permanence of the Bushman's paint is amazing, and in many of the shallower rock shelters, even though little protected from the wind and weather, there are still clear paintings. The Bushman painted chiefly in shades of red, brown, and maroon, in black, white, and yellow—colors that were derived from mineral ores. The reds and browns were made from hematite, the white from zinc oxide and bird droppings, the yellow from iron pyrites, and the black chiefly from the charred wood of their campfires. They ground the minerals and mixed them with animal fat or bone marrow, which must have given the paintings when they were new an excellent brilliance and gloss. The Bushmen generally used brushes made of feathers, though there were variations in materials and equipment, just as there were in techniques. There are indications that some spread the paint with their fingers and that others used specially prepared tendons as brushes.



▲ PROF. VAN RIET LOWE uses transparent film for recording the paintings. He has just traced a little man fleeing from a charging lion. A few of the frescoes that were threatened with destruction have been given museum protection, but countless thousands are not even recorded



► WHEN THE PAINTING has been traced as shown here, it is transferred to linen paper

The various developments in technique and materials were no doubt slow. Some must have taken hundreds or thousands of years. The peak of Bushman art was reached in the centuries before the bands of Little People were decimated by the invasion of new races from the outside—first the Hottentots pushing down from the north along the west coast, then the Bantus from the north along the eastern escarpment of Africa, and finally the Huguenots and the Dutch pushing northward from the Cape.

Archaeologists believe that the last Bushman artist finished his final painting about 100 years ago. In one cave on the eastern edge of the Orange Free State, they found a crude rock painting that unmistakably depicted the Voortrekkers, the pioneers of South Africa who migrated northward from the Cape to escape the control of the English between 1835 and 1840.

But exactly when the art of rock painting began and just who began it is still one of the great enigmas. Anthropological studies so far indicate that the Bushman, who finally gave way to invaders, was at one time himself an invader of the southern end of the Dark Continent. That was well over 1000 years ago, according to Professor Schapera's estimates in his studies of the Bushman and the Hottentot, *The Khoisan Peoples of South Africa*.

That there were earlier civilizations than the Bushman there is little doubt, but of them little is now known. Recently one excavation revealed what archaeologists believe to be a skeleton of one of those pre-Bushman races. They labeled it "Boskop Man." Another search produced the skeletal bits of another prehistoric man, which they named the "Strandlooper" and which showed evidence, according to Professor Schapera, of "an

occasional amalgamation" between the Bushman and the Boskop.

But whether it was the Boskop Man, the Strandlooper, or some entirely unknown race of primitives that was responsible for the earlier rock paintings is still a matter of conjecture. The Bushman and Boskop men actually are relatively recent in the archaeological scale of time, and yet paintings have been found in caves all along the escarpment of Africa.

"The physical condition of many of these panels show them to have been at least sub-fossil, many of the figures being difficult to see, their color has sunk into the rock," Abbé Breuil observed. "Their physical state is just as fossilized as that of the Upper Paleolithic rock paintings and the Neo-Eneolithic ones of the Iberian peninsula . . ."

Lately, excavations in the Paul Loewenstein cave near Ladybrand, in the Orange Free State, brought to light bits of yellow ochre of the type used in the earliest paintings. They were found in a layer that Professor van Riet Lowe estimated to be between 10,000 and 15,000

years old. But whether the ochre was used for rock paintings or body adornment is still conjectural.

A few of the rock paintings present the ethnologists with fascinating puzzles. One painting in a cave in Southern Rhodesia shows a group of white people, which from their dress appear to be ancient Greeks, busy with their baths. Still another sketch in southwest Africa near Windhoek is of a white woman, whose shoes, dress, and posture recalled to the Abbé Breuil the "statuettes and frescoes of Knossos in ancient Crete." In other caves in the southeastern part of South Africa are files of white-faced, bearded soldiers who wear shoes and sometimes conical helmets that suggest the ancient civilizations of the Mediterranean.

"These various scenes," the Abbé commented, "seem to me a reflection in Bushman art of the passage of columns of prospectors coming from the Persian Gulf at the time when the antique civilizations of Nineveh and Babylon and north-west India, flourished. It is impossible to say more. All these 'exotic'



➤ BACK in his office, Prof. van Riet Lowe at work on tracings from a cave in Mont aux Sources, so named because it is the source of many rivers in the Union of South Africa





▲ AN EARLY BUSHMAN PAINTING thought to represent a "Praying Mantis" ceremony. The mantis in human form is a grotesque totem or fetish, apparently connected with rain-making rites. Orange Springs Cave, near Ladybrand, Orange Free State



► A BUSHMAN PAINTING of a man with a bow and arrow. Its estimated age: less than 1000 years

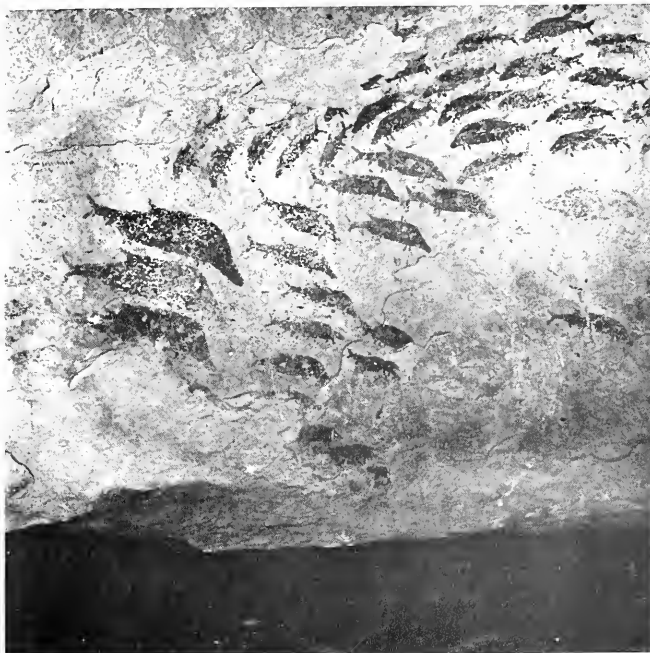


▼ A SCHOOL OF DOLPHINS painted by Bushmen on the wall of a cave 200 miles from the sea, on the Uysberg Farm, near Ladybrand

pictures belong not to an opening state in South African rock art but to the peak of its expansion, throwing back farther still its origin beyond the 3,000, 4,000, or 5,000 years of the ancient historical civilizations to which we have referred."

These mysteries are only part of the uncounted, unanswered questions that face the small assemblage of experts studying them. When and if a complete study of the thousands of sites is ever made, many more enigmas will undoubtedly be uncovered. It is a fantastically big job—one that has its limitations in time, because every additional year of wind and weather subtract a little more from the clearness of the paintings. Wind and sand, sun and water, heat and cold, already have bombarded untold numbers of the earlier paintings into unrecorded oblivion.

*Readers are referred to a previous article on this subject by Nels Nelson, in the November, 1937, issue of NATURAL HISTORY.*







# OSPREYS *of Ventana*

A voyage in the Gulf of Lower California leads to close acquaintanceship with the fish hawk, a bird that harms no one and should not be harried out of existence

By LEWIS WAYNE WALKER

*Photographs by the author*

▲ THIS YOUNG OSPREY was already showing the defiant spirit of its parents, who even put a dent in a flashlight reflector left in position for remote-control photography

A HUNDRED miles south of the California-Arizona border lies the tip end of the Sea of Cortez, a tremendous body of water dotted with islands, which, in turn, are dotted with the nests of ospreys.

These impressive birds were formerly widely distributed throughout most of the tropical and temperate world. Some people may associate them with tree-bordered lakes, but actually they are as much at home on a scorching desert sea coast as elsewhere, a fact proved by their abundance along the full length of the Gulf of California. The vegetation of the region is meager and mainly limited to stunted elephant trees and giant cardon cactus, the Lower California saguaros. Lizards, rattlesnakes, and pack rats form the bulk of the islands' terrestrial animal life, while giant sea turtles and graceful porpoises play in waters which are rarely disturbed by churning propellers.

In a few localities the ospreys



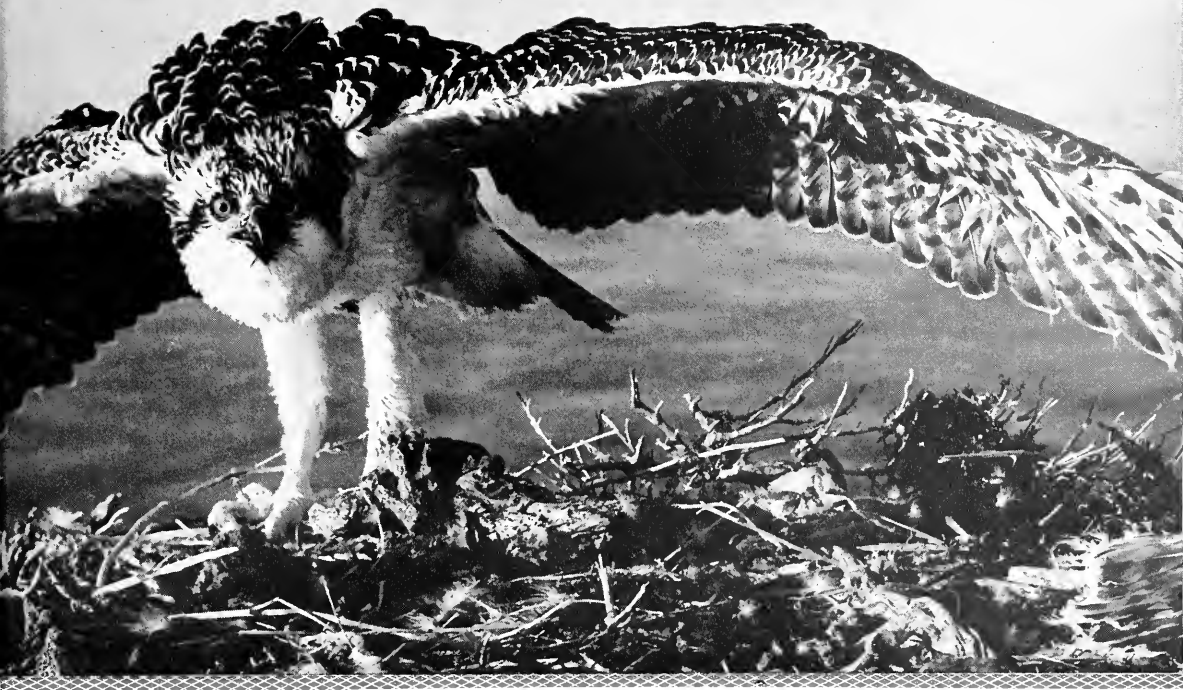
▲ A NATURAL CITADEL selected by the adult birds for their nest—a rock appropriately named Ventana, or "window"

nest in the crotches formed by the branching arms of the giant cactus, but the birds far outnumber available plants, and so most of them are forced to place their bulky nests on rocky pinnacles. From a photographer's point of view, any one of these nests would be an ideal camera subject, but there are so many from which to choose that a traveler is baffled by their num-

bers. To a certain extent the legendary "mañana" complex of the country takes over, and I passed nest after nest, deciding each time to return on the morrow. Then I found Ventana, the "window-rock."

This tremendous triangular pile of rock reared in the air a hundred feet wide at the base and as many feet tall. A stone's throw away was a larger island, one of the many in





▲ THE YOUNG BIRD, even at this age, was not reluctant to charge the author

the beautiful bay of Bahia de Los Angeles. Winds and tidal current have worked on Ventana, but instead of wearing the rock around its circumference, they have tunneled a hole through its middle, creating a natural arch as a perfect frame for the bay and the hills beyond. At its topmost point a bulky pile of sticks juttied up for another five feet to form the prize eyrie of them all—a rugged beauty that words cannot adequately describe.

The size of this nest was indicative of long occupancy by ospreys, yet my first visit convinced me that it had never before been molested by humans. At every step of the steep climb an avalanche of loose stones was started, and I literally carved a trail to the summit. Within a slight depression on top of the pile of sticks reposed two chocolate mottled eggs.

All during my ascent, the adults had flown overhead, constantly whistling defiance; but as I climbed and finally reached the base of their home, their vocal threats changed to action, and every ten or fifteen seconds I was forced to duck the reckless attacks of the nesting birds. They missed me by mere inches

and became braver with each dive. Finally, when air turbulence ruffled my hair, I picked up a two-foot stick and held it above my head for protection. It was promptly knocked out of my hand and into the water far below.

The adults usually worked in conjunction like a well-rehearsed team, but I noticed that there were short periods when only one bird guarded the nest. Then, each time that the missing mate returned to repeat the diving tactics, I would be showered with a fine spray of water from dripping feathers. This water spraying was just a by-product of the bird's method of keeping cool in the heat of constant attacks. When, through exertion, body temperature "reached a boiling point," the bird would soar off on a long, fast glide. Just above the surface it would dangle its long legs and create a filmy blanket of spray. These nonstop aerial baths often left a wake of a hundred feet or more in length. The whole procedure of repeated dives and short "time outs" was reminiscent of a prize fight with its three minutes

of strenuous battle and a minute of refreshing rest.

A month later I again visited Ventana, and in place of the eggs there were twin young. Despite their tender age of less than a week, the chicks were obeying commands of their parents, evidently given as my boat approached the rock. Both of the young were flattened against the debris as though pressed into place with a weight, and although their eyes were half open and watching my movements, they gave no other sign of life. One that I picked up and rolled on its back remained rigid for many minutes. Then it gradually twisted its neck into a half-turn and placed its lower mandible flush with the nest. Dust and fish scales, dislodged when I set up the camera tripod, floated about the dry platform, and some of these particles settled in the open eyes of the young. Still no movement was to be seen, although such irritation would have been unbearable to a person and would have caused one to break the sternest of parental commands.

After the camera was set and

focused on the nest, I retreated toward the base of Ventana with the electric remote-control cord in my hand. As I inched my way down, Chappo, the boatman, gesticulated wildly and pointed to the nest. I paused in my descent and glanced back at the eyrie to see camera and tripod dangling over space, held aloft by an electrical plug and a cord that had snagged on a projecting boulder. Later, when I gingerly pulled the equipment to the top, dents and talon marks on the reflector showed that the dives of the adults were not always intentional misses.

A month later and after 400 miles of island-hopping in the central section of the Gulf, I returned to Ventana once more. From a distance, the twin young, almost as large as their flying parents, could be seen standing in the nest. At the first whistled warning, they fell flat on their breasts in the same freeze that

they had used as chicks. But with growth and strength had also come independence, and now when I turned one over, he flopped right side up and then with open wings tried to rush me off the nest. The adults, so worried on previous visits, were now more tolerant and were content to circle 50 feet above and whistle advice to their offspring.

Two hours were spent in the vicinity, and throughout this period a fourteen-inch mullet was constantly carried in the talons of one of the parents. This fish, almost half the bird's length, was handled in an effortless manner and was carried headfirst into the line of flight to minimize wind resistance. Later, as our boat left the ospreys' domain, the burdened hawk was seen to zoom up and above his flying mate and then release his hold on the prey. As it hurtled downward, end over end, the lower bird

snatched it out of the air and flew in to feed the young.

At an age of about a month and a half, the young were seen practicing flight on the hogback ridge, and a few days later they were found on the beach of the larger island near by. The parents spent most of their time circling lazily over the bay on the watch for finny prey in the waters below; and when a fish was sighted, a bird would hover over the spot until it approached the surface and then go into a speedy, headlong dive. When 25 feet from the water, the wings would be raised and talons extended to maximum length. A fraction of a second later the bird would almost disappear from sight, completely enveloped in a shower of spray. After a short struggle, with wildly beating wings, the hunter would once more become airborne. On regaining altitude, the fish would be deftly shifted to its headfirst position and then taken to the beach and fed to the waiting young, soon to be on their own.

▼ YOUNG raised in captivity and without instruction from their parents have developed the osprey technique of catching fish. The fish is usually carried headfirst to reduce wind resistance



# TURRET EYES

The daddy longlegs has eyes in a turret, but still he can't see very well

By EDWIN WAY TEALE

*Photographs by the author*

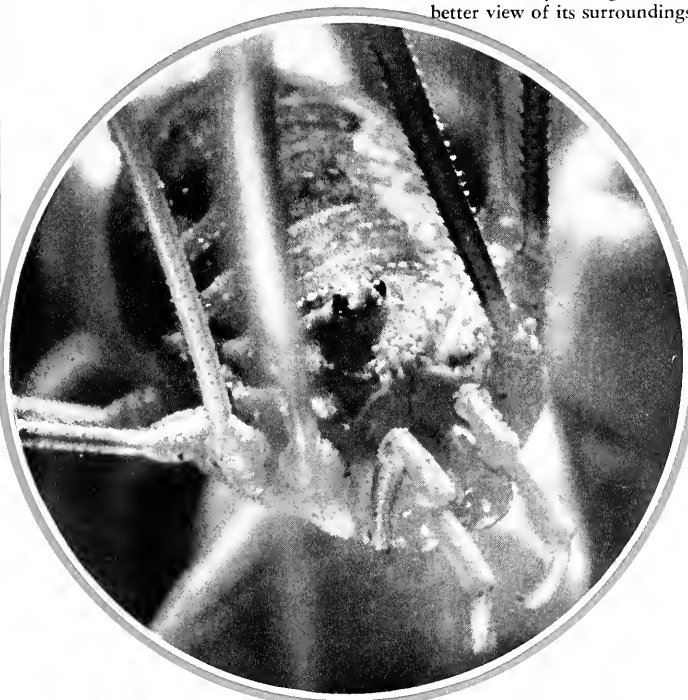
**I**F a daddy longlegs walked as we do, its body would be lifted well above the ground at the top of its slender stiltlike legs. It would form a kind of natural lookout tower. Instead, it moves along on legs that are bent, its "knees" rising high above its seed-shaped body. The body bobs along almost touching the ground. In this position, the grandfather graybeard, as it is sometimes called, is better able to detect its food by touch and taste. But it is handicapped in the matter of seeing around it, for its low viewpoint limits its horizon.

A close examination of one of these familiar creatures reveals the curious position of its eyes. They are located in a little tower or tur-



▲ A DADDY LONGLEGS, or harvestman, on the blooms of a white funkia

▼ CLOSE-UP of a harvestman, showing the little turret that rises above the creature's body and gives it a better view of its surroundings



ret that rises from the upper side of the body like a conning tower on a submarine. This turret holds two eyes, one facing to the right, the other to the left. In this position, the eyes have increased effectiveness. They are lifted above the body, situated in an open space, better able to see what is going on around them.

And the daddy longlegs needs all the aids to better vision that it can possess, for its two organs of sight are of extremely low efficiency. They are hardly better than the simple eyes, or ocelli, that are found between the great compound eyes on the heads of many insects. But this creature, like most arachnids, is largely nocturnal. The main function of its eyes is to detect the difference between light and dark. So, even though it carries a living lookout tower about on its back, the so-called harvestman probably sees—in varying degrees and shapes—only masses of light and dark in the world about it.

# March of the

Its sudden advance around half the circumference of the world

By R. TUCKER ABBOTT

Assistant Curator, Division of Mollusks,  
U. S. National Museum

is a serious menace to agriculture

THE sergeant was enjoying the cool of the evening as he drove his jeep down the steep and winding jungle road. Although orders were still in effect to drive at a snail's pace on Saipan's mountain roads at night, he apparently had no need of reducing speed more than was required to make the sharpest turns. On one of those rare, straight stretches, the jeep picked up speed. Suddenly, the sergeant saw that the road ahead was littered with large stones. He braced himself for the jolts and applied his brakes. But under the wheels the stones popped and crunched like hens' eggs. Then the jeep skidded, and the beams of the headlights tangled with jungle vines and went out.

The dazed sergeant crawled out of the ditch and limped back onto the road with flashlight in hand to investigate the "stones." A long whistle of wonderment escaped his lips. These were not stones. They were dozens of huge, crawling snails, many nearly half a foot in length! All were marching across the road, and the smeared carcasses of a number of them marked the skid trail to the ditch where the wrecked jeep lay on its side.

The strange story of the swarms of giant snails found by the sergeant and others on Saipan Island after its capture from the Japanese has its beginning some 8000 miles to the west of the Mariana Islands. Before man began his extensive trading voyages throughout the In-

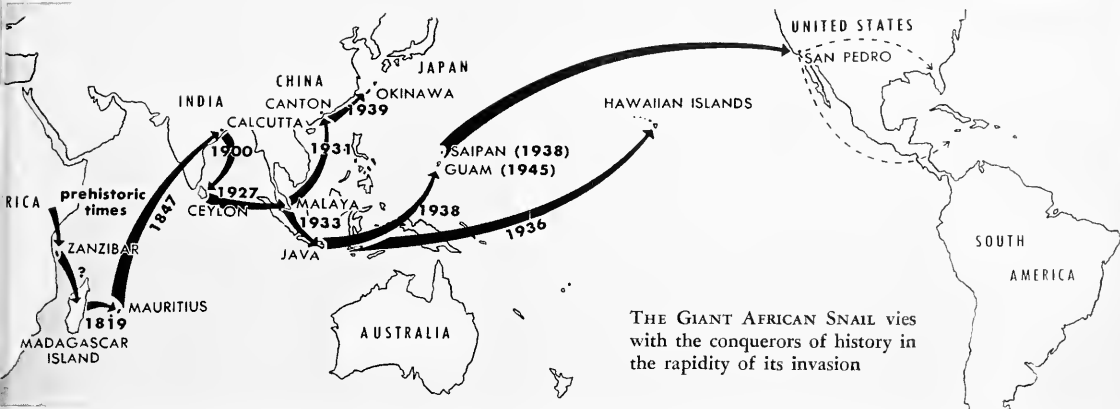
dian and Pacific oceans, the giant African snail (*Achatina fulica* Ferrussac) was limited to the Island of Madagascar and probably the mainland of Africa. The very early history of *Achatina*'s march around half the face of the globe is obscure; but since 1803, man has recorded its introduction into a score of foreign lands, with the latest invasion taking place in southern California.

The sudden appearance of snails of such unusual size, the rapidity with which they reproduce, and their destructiveness to succulent plants and young sprouts have caused man to turn battle against these molluscan invaders in a score of places around the world. Alarming destruction to truck crops in the Mariana Islands and the recent accidental introduction of this snail into the United States have added a new chapter to the story. Will

▼ IN SIZE, it is a veritable nightmare of a snail. Extended from its five-inch shell, it may measure nine inches or more overall. (*Achatina fulica* Ferrussac)

Photo courtesy of Ernest P. Walker





other chapters soon be added, such as "Giant Snails Raze Florida Tomato Crops" or "Cubans Battle Giant Snail Visitors from the United States"?

The menace is so real that the National Research Council, at the request of the United States Navy and its Office of Island Governments, has recently set out to find some solution to the problem. Already, Dr. Francis X. Williams, a scientist renowned for his successful fight against insect invaders of the Hawaiian Islands, has been sent to the home of the *Achatina*s in tropical Africa. His job is to learn as much as possible about the snail's habits and natural enemies. What he discovers will be used in our all-out attack on the snail in the Pacific.

One of the advisers to this project, and without question the leading authority on African land snails, is Dr. Joseph Bequaert, who was formerly on the staff of the American Museum of Natural History and is now a curator at Harvard's famed Museum of Comparative Zoology. The largest collection of *Achatina* snails, including nearly all of the known species, is housed at Harvard University. Of the several dozen species of *Achatina*s, the Pacific invader is by no means the largest; it has gained the name "giant" only because of its size in relation to the smaller snails of India and the East Indies. *Achatina achatina*, the King Kong of land snails, has perhaps the more rightful claim to the name "giant African

snail"; but probably because of its special environmental or food requirements, it has never successfully invaded other lands.

The first published record of *Achatina fulica*'s appearance outside of Africa and Madagascar was made by the French naturalist L. A. Bosc, who in 1803 recorded it from the Island of Mauritius, some 700 miles east of Madagascar. Also about that time, the French governor of Reunion Island dispatched a ship to Madagascar to obtain living specimens for his gardens. It appears that the favorite young lady of the governor had acquired a taste for snail soup, which in those days was considered a sovereign remedy for tuberculosis.

Responsibility for the snail's first introduction to the mainland of Asia can be traced to the well-known malacologist W. H. Benson. While visiting a friend to collect mollusks in Mauritius in 1847, he became sufficiently interested in these giants to bring back living specimens to Calcutta, India, where he released them in the garden of the Bengal Asiatic Society.

Since Benson's day the giant African snail has made a steady march eastward, with serious outbreaks occurring in the Seychelle Islands prior to 1868 and in Ceylon in 1900, where it attacked young tea plants. It made its presence known in Perak, Straits Settlements, in 1927 and in Malaya in 1928, where it destroyed thousands of young rubber plants. By 1930, it was in the gardens of Singapore and

a year later in Southern China. It hit the Rhio Archipelago, Netherlands East Indies, in 1933; then Java in 1935; Palembang, Sumatra, in 1936; and Siam before 1937. The snail has appeared from time to time in the Hawaiian Islands, but thanks to the vigilance of Dr. C. M. Cooke, of the Bernice P. Bishop Museum, colonies introduced have been stamped out each time before the situation reached the epidemic stage.

The Japanese introduced *Achatina*s to Saipan and Tinian Islands in the Mariana Islands for food purposes some time before 1940. Although the Japanese were very fond of *Achatina* stew, the natives did not acquire a liking for it. When American troops occupied these islands in 1945, the snails were so abundant that driving was dangerous because the roads were made slippery by hundreds of crushed snails. The author has seen as many as 50 large *Achatina*s clinging to a small 10-foot tree on Saipan Island. Dr. E. E. Green, in 1911, reported a similar condition in Ceylon, where 227 snails were counted on the stem of a coconut tree. The ground beneath was covered an inch deep with excreta.

In 1946, when pandanus leaves were being shipped from Saipan to Guam for native handicraft, the snails soon appeared on the outskirts of a village not far from Agat on the west shore. No serious effort was made by the authorities to control the invader, and by 1947

the colony had enlarged and spread over most of southern Guam. At present, a similar epidemic is raging in the Palau Islands.

United States is the most recent port of call for *Achatina*, living adults having been found in gardens in San Pedro, California. The theory has been advanced that eggs or estivating adults were brought in on army vehicles from Tinian Island soon after the war. It would be regrettable indeed if the snails established themselves in California's great truck-farming areas. Fortunately, the climate of that state is not considered to be entirely ideal for the snail. In Malaya, agriculturists were concerned as much with the ability of the snail to mechanically transport common plant diseases, such as the "root disease" of sugar cane, as they were with its destructiveness to sprouting rubber plants.

Adult *Achatinas* seem to prefer rotting vegetation, fallen fruit, and even human excreta as the main part of their diet, but younger snails take an active part in attacking succulent vegetables and the sprouts of certain economically important plants. In Ceylon, where the rocks are almost purely granite, there is no limestone, and doubtless because of this the snails have developed a passion for whitewash. They crawl up buildings in order to lap it off; and this is now turned to account in keeping down the pests. Little bags of poisoned whitewash are hung in spots where they are likely to find and eat it.

Biological control by the introduction of natural enemies or diseases that keep the snails in check in their native Africa is a method that holds great promise, but offsetting this is the gamble of a biological backfire. It sometimes happens that the controlling agent successfully checks enemy No. 1 only to become a menace to harmless creatures. There are small carnivorous mollusks in Africa that attack *Achatina* snails. If introduced to the islands, would they not only eliminate the African giants but turn to wipe out the beautiful *Partula* snails, which are used extensively for native jewelry?

Other enemies of this species of *Achatina* have been observed in several countries, but their effectiveness in control has been negligible. In Africa, large lizards have been known to feed upon them. In Ceylon, the common Pond Tortoise (*Nicoria*) is the only animal that has been observed to attack them. In the East Indies, rats have occasionally gnawed open the shells. The larvae of the Indian Glowworm (*Lampyrophorus*) will attack and devour young *Achatinas* at night, but their inability to check their numbers is attested by the fact that by 1910 large colonies were fairly common over most of northern Bengal.

One cannot always predict how one particular species will behave in a foreign land, whether it be snail, monkey, or man. *Achatina* is almost exclusively a ground dweller in Africa, yet in the East Indian and the Pacific Islands it has taken to arboreal habits in great measure. Whether this particular paradox is due to the development of a new strain of this species or is brought about by the necessity of seeking new tree-dwelling foods, such as lichens, is not known.

There is still another approach to their control, one that calls for the combined planning of the biologist, fisheries expert, and economist. It has been suggested that small canneries be set up in the islands where the *Achatinas* could be harvested, prepared for canning in the manner of squids, and shipped to the Japanese markets. It is possible that their gastronomic appeal might vie with the most favored of Japanese seaweeds, holothurians, and octopi.

Temporary measures to protect crops and gardens have met with varying degrees of success. A price was put on *Achatina*'s head in Malaya, and in a single day several thousands were collected and carried out to sea. Unfortunately, the wind turned to an unfavorable quarter and washed most of them ashore alive! It was soon learned that piles of collected snails had to be buried or burned with the aid of gasoline. Poultry dealers introduced them from Singapore to

Sarawak for chicken food, and two years later a program of eradication had to be started. In fifteen days, half a million adults and twenty million eggs were destroyed. In a year or so, the snails were as plentiful as before. Rubber planters developed poisoned bait-balls of rice bran and a poison of a compound of metaldehyde. Miniature tents of corrugated iron sheeting were put over the bait-balls to prevent hardening by the sun and melting by the rain. Their success was moderate. DDT is likely to have little or no effect on snails, since mollusks lack the chitin for which that chemical has such an affinity in the case of insects.

*Achatina*'s powers of reproduction are excellent. In a year, the young are old enough to begin laying eggs. Usually 300 eggs are laid at one time, and it is believed that the snail repeats the operation every few weeks during rainy spells. The round, yellow, pealike eggs are laid at night under protective leaves on the ground in a mucous glob about the size of a cucumber. The adults have both male and female reproductive organs in the same individual, so that each fully grown snail contributes to the increase of the colony. Three hundred eggs at one sitting is by no means startling for a mollusk; a single oyster sometimes reaches the 60,000,000 mark. What prevents the ocean from filling with oyster shells in a few years is the enormous death rate among the young. Apparently, in the Pacific Islands where natural enemies are absent, the death rate among young giant African snails is quite low.

A "worm's eye" view of the animal of the *Achatina* snail is not particularly attractive. The moist, rubber-like skin of the body and face is granulose in texture, with a number of longitudinal furrows running along the neck. The color of the skin is a subdued brownish black. Mounted on the head are two pairs of feelers: a pair of short tentacles and, above them, two larger eye peduncles. At the tip of each of the latter is a round, bulbous eye. The fleshy peduncles are constantly moving from side to side



and changing in length. If the eye is touched, the snail immediately shrinks the peduncle to almost one-fourth its original size. Oddly enough, the creature accomplishes this by pulling the eye down into the peduncle itself, just as you might turn a stocking inside out.

If we could imagine an *Achatina* snail as large as a cow, we would undoubtedly be horrified at its ability to chew and engulf vegetable matter. The mouth is armed with a horny jaw, behind which is an impressive set of over 80,000 tough teeth. The individual teeth, which are arranged in rows along a tongue-like ribbon, are made up in the form of small oblong blocks, each bearing a strong pointed hook. At times, when the mouth of the snail is pressed firmly against a piece of glass, the glint of flashing

teeth can be seen as the ribbon moves back and forth.

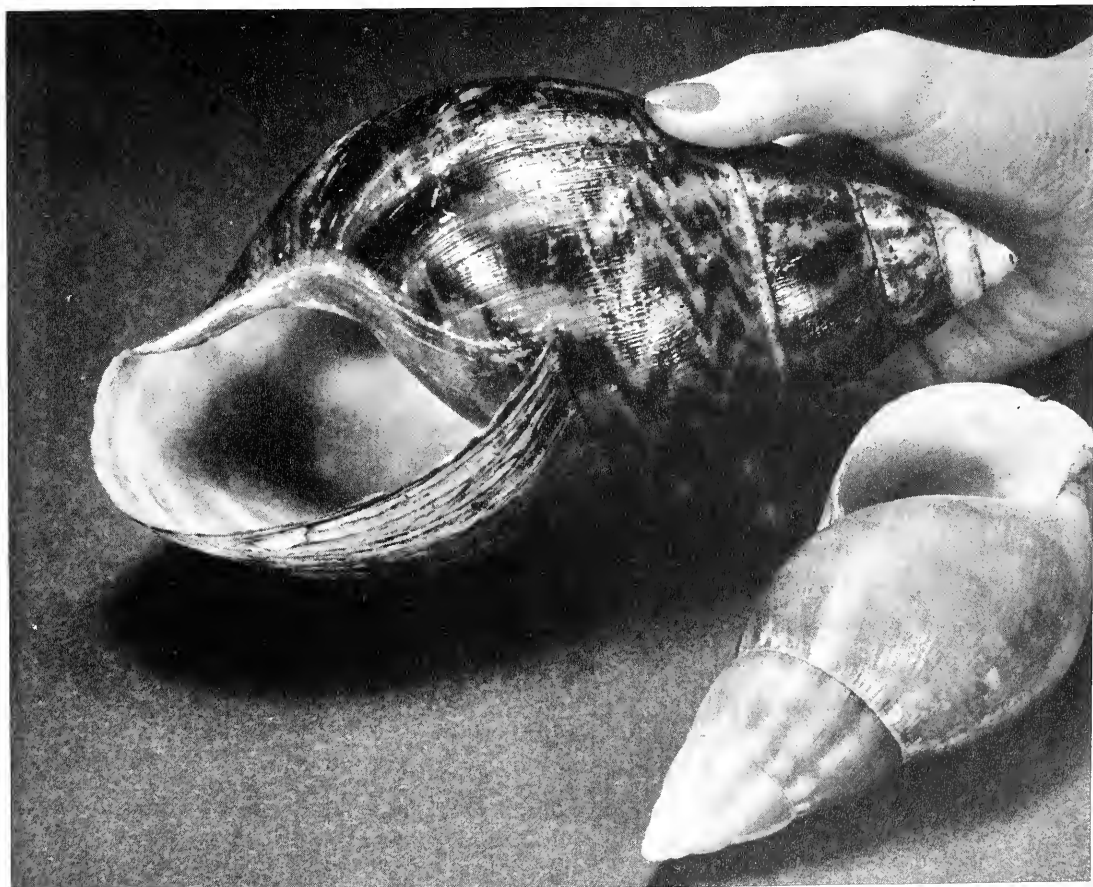
While protected by the mucous matrix, the eggs are rubbery to the touch, but if separated from this moist, protecting sheath, their outer calcareous shells become extremely hard. Their bouncing qualities on the laboratory table are equal to those of golf balls. Yoshio Kondo, one of Hawaii's mollusk experts, has carried out a number of interesting experiments with the eggs and young of *Achatina*. Not the least strange of these were the "ship-in-a-bottle" experiments. Jars and bottles of several sizes and shapes were laid on their sides, and miniature gardens were carefully

cultivated inside. A newly hatched *Achatina* snail was then introduced into each bottle and allowed to grow. For months water and food were passed through the necks of the bottles to the ever-growing snails. Their shells increased normally until no more room was available. Many of them continued their growth to take on bizarre, elongated shapes. When the desired oddity in size or shape had been acquired, the bottle, garden, and snail were boiled a few minutes in water and then meticulously cleaned of all meat, soil, and vegetation. Result: a beautiful giant African snail shell enshrined in a bottle.



▼ A CLOSE RELATIVE of the destructive snail is even larger, as shown here. The one in the hand is *Achatina achatina*

AMNH photo





New York Zoological Society photo by Sam Dunton

▲ STATELY SCALARES swim amongsprigs of water sprite, *Vallisneria*, and *Cryptocoryne* in a small aquarium

# The Myth of THE BALANCED AQUARIUM

THE idea that the animals and plants of an aquarium balance each other in their production and consumption of carbon dioxide and oxygen was a little over 100 years old when it was proved wrong. Although it was disproved more than seventeen years ago, the myth of the balanced aquarium still holds sway—in the tropical fish fancy, in the schoolroom, and in the laboratory. Such is the power of the too felicitous phrase, the too trim theory.

Joseph Priestley was the first to demonstrate the reciprocal action of plants and animals on the atmosphere, when he showed that a limited amount of air in which rats were smothered would again support more of them after green plants had remained in it for a time. In 1777, he also reported that fishes affect the water in which they live in the same way that terrestrial animals affect the air surrounding them, although he appar-

If you have been planting vegetation in your aquarium on the ancient theory that your fishes need the oxygen it produces, you will be interested to know how it is really affecting them

By JAMES W. ATZ

Assistant Curator, New York Aquarium,  
New York Zoological Society  
Drawings by G. MILES CONRAD

ently had not availed himself of Robert Boyle's experiments, performed a century earlier. Boyle showed that a fish breathes air dissolved in water, since it dies when its container is placed in a chamber from which most of the air is exhausted by a vacuum pump or when its glass is quite filled with water and so closely stoppered that it cannot enjoy the benefit of air.

Priestley paved the way for the fundamental work of Ingenhousz, de Saussure, and Senebier on plant physiology and of Lavoisier on the chemistry of animal respiration. Thus by the first decade of the

nineteenth century it was well established that plants, like animals, respire, taking in oxygen and giving off carbon dioxide, but that in the presence of strong enough light this function is far overbalanced by the assimilative one, later called photosynthesis, in which carbon dioxide and water are consumed and oxygen released.

We realize today that almost all the oxygen in our atmosphere results from the photosynthesis of plants, so the savants of Priestley's time were not incorrect in emphasizing the far-reaching importance of this plant-animal relationship. But they gave it a teleological twist,

using it to illustrate the marvelous goodness of the world in which man lives. "From these discoveries we are assured that no vegetable grows in vain," declared Sir John Pringle, President of the Royal Society in 1773, "but that from the oak of the forest to the grass of the field, every individual plant is serviceable to mankind; if not always distinguished by some private virtue, yet making a part of the whole which cleanses and purifies our atmosphere. In this the fragrant rose and deadly nightshade co-operate: nor is the herbage, nor the woods that flourish in the most remote and unpeopled regions unprofitable to us, nor we to them; considering how constantly the winds convey to them our vitiated air, for our relief, and for their nourishment."

This florid vein continued on into the cynical twentieth century, when J. E. Taylor wrote, in 1901, that "every teacher in physical geography now imparts to his class that the oxygen generated in the virgin forests of the Amazon valley may be brought by the wind to bring health to the fetid streets and alleys of crowded European cities, and that in return the carbonic acid breathed forth from our overpopulated towns may be carried on the 'wings of the wind,' to be eventually absorbed by the incalculable stomata which crowd the under surfaces of the leaves in the same forest-clad region!"

These were the compost-mixers

for our myth; they prepared each successive generation with successively more fertile minds for its seeding and growth. Who, preoccupied with the world-wide implications of the balance between plants and animals, could suspect that so insignificant a part of the earth as a home aquarium would not conform?

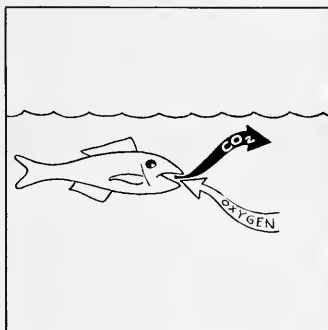
The first aquarium: where and when was it devised? The word itself was not used to indicate a container of water with aquatic animals living in it until 1852; but before that, who was the first to keep fish captive in some small, water-containing receptacle? As far back as 2500 B.C., the Sumerians kept living fishes for food. The ancient Romans had pet moray eels and mullet, while the Chinese domesticated the goldfish in the Sung Dynasty (960-1278), but all these fishes were maintained in pools or ponds. There is evidence, however, that in some places in China goldfish were kept indoors in porcelain vessels during the winter months. Perhaps these were the first aquaria, although we cannot be sure.

If we consider the aquarium properly to be only a glass or glass-sided water container, we can fix its origins a little more definitely. The earliest record of putting fish into glass containers comes down to us from the Romans of the first century. They did not do this for the purpose of keeping the fish alive, however, but to watch their

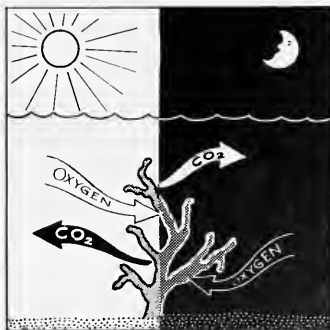
change of color as they died.

The maintenance of fish in small glasses was still noteworthy enough in 1746 to warrant the publication of Fellow William Arderon's letter "on keeping of small fish in glass jars" in the *Philosophical Transactions* of the Royal Society of London; yet this was certainly not the first attempt to do so. According to Boyle, Guillaume Rondelet, a Renaissance student of aquatic life who died in 1566, once claimed that his wife had kept a fish alive in a glass of water for three years. Samuel Pepys, indefatigable recorder of minutiae, made the following entry in his diary on May 28, 1665: "Thence home and to see my Lady Pen, where my wife and I were shown a fine rarity: of fishes kept in a glass of water, that will live so for ever; and finely marked they are, being foreign." My Lady Pen, incidentally, was the mother of William Penn of Pennsylvania.

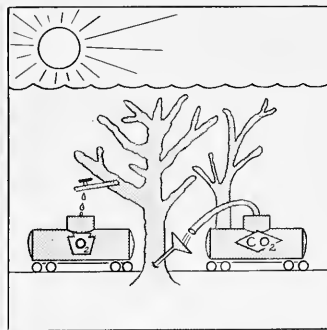
But the keeping of fishes as pets did not become a popular pastime until after the goldfish was widely introduced into England during the first half of the eighteenth century. At first they were maintained in ponds on the lands of the well-to-do. Sir John Hawkins, noted editor of Izaak Walton and Charles Cotton, wrote in 1760: "There has also been lately brought hither from China, those beautiful creatures Gold and Silver Fish... These fish are usually kept in ponds, basons and small reservoirs of water, to which they are a delightful orna-



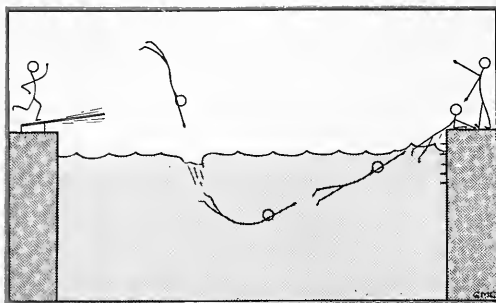
Fishes, like people, breathe oxygen [dissolved in water] and give off carbon dioxide



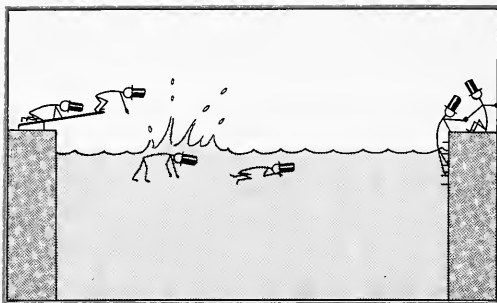
Plants use oxygen and give off carbon dioxide day and night, but in daylight an opposite process overshadows this



Under the influence of light, plants use larger quantities of carbon dioxide and give off larger quantities of oxygen



Oxygen escapes readily from water and is quickly absorbed by it



Carbon dioxide, unlike oxygen, moves sluggishly from air into water or vice versa

ment; and I have known a few of them kept for years in a large glass vessel like a punch-bowl. . . ." In the second and third editions of *The Complete Angler* which he edited, dated 1766 and 1775 respectively, the above footnote was repeated, but in the fourth edition, printed in 1784, Hawkins saw fit to alter it, stating that "it is now a very common practice to keep them in a large glass vessel like a punch-bowl. . . ." The Reverend Gilbert White corroborates Hawkins in Letter LIV of *The Natural History of Selborne*, based on an entry from his Journal dated October 27, 1782: "When I happen to visit a family where gold and silver fishes are kept in a glass bowl, I am always pleased with the occurrence, because it offers me an opportunity of observing the activities and propensities of those beings with whom we can be little acquainted in their natural state."

If we accept this evidence at face value, we can declare that between 1775 and 1784 the goldfish bowl became a popular household appliance in England.

The elements of our myth were now at hand; it only remained for someone to apply the principle of plant-animal balance to an aquarium by growing aquatic plants in it.

Looking at the matter in historical perspective, one is not impressed by the ingenuity of the idea or surprised that a number of people claimed to have stumbled upon it independently and more or less at the same time. The wonder is, perhaps, why no one hit upon it before. For it was not until after

1840 that aquarists began to employ aquatic plants in their tanks. Moreover, it was a French invertebrate zoologist, Charles des Moulins, who first claimed to have discovered that the presence of green plants in small containers of water kept that medium suitable indefinitely for small animals (planarians in this instance) and who attributed this effect to the physiology of the plants. Charles des Moulins was President of the Linnaean Society of Bordeaux, and he reported his experiments in the *Actes* of that organization in 1830.

Credit for the earliest clear enunciation of the benefits resulting from the interactions between aquatic plants and fishes should, however, go to the author of a chemistry textbook, William Thomas Brande. As early as 1821, his *Manual of Chemistry* stated: "Fishes breathe the air which is dissolved in water; they therefore soon deprive it of its oxygen, the place of which is supplied by carbonic acid; this is in many instances decomposed by aquatic vegetables, which restore oxygen and absorb the carbon; hence the advantage of cultivating growing vegetables in artificial fish-ponds." That this information should appear in a book on chemistry makes one wonder if it were not common knowledge among fish culturists of the time, but a search of the literature has failed to reveal even an allusion to it.

Perhaps this disjunction of knowledge explains why the five or six amateur and professional biologists who at this time came upon the

idea of using plants to "purify" their aquaria, each claimed to be the originator of it and why they quarreled (albeit genteelly) as to who was the first among them to do so.

One of them, Robert Warington, later said that it was Brande's statement that had incited him to set up his experimental tank with goldfish and tape grass (*Vallisneria*). Warington was a chemist himself, and his was the first unequivocal exposition of the conception of mutual interdependence of the plants and animals in a small container of water. Both des Moulins and George Johnston, who had worked with sea water, marine animals, and seaweed previous to 1842, had been somewhat vague in their writings. Not so Warington. His paper, read before the Chemical Society of London early in 1850, is perfectly clear and could be used today as a summation of what practically all teachers, most aquarists, and many professional biologists believe: "Thus we have that admirable balance sustained between the animal and vegetable kingdoms, and that in a liquid element. The fish, in its respiration, consumes the oxygen held in solution by the water as atmospheric air; furnishes carbonic acid; feeds on the insects and young snails; and excretes material well adapted as a rich food to the plant and well fitted for its luxuriant growth.

"The plant, by its respiration, consumes the carbonic acid produced by the fish, appropriating the carbon to the construction of its tissues and fibre, and liberates the

oxygen in its gaseous state to sustain the healthy functions of the animal life, at the same time that it feeds on the rejected matter which has fulfilled its purposes in the nourishment of the fish. . . ."

The key word was "balance," and it appears in the writings of N. B. Ward, Philip Henry Gosse, Edwin Lankester, and Mrs. Anne Thynne, co-claimants for the honor of first applying the oxygen-carbon dioxide interactions of plants and animals to small aquaria. Probably the first to set up a tank containing both fish and plants with the idea of balancing one against the other was Nathaniel Bagshaw Ward, an English botanist, who originated the Wardian Case, that glass-sided box with ferns and other plants growing inside it so often seen in latter nineteenth century parlors. Whether it was this miniature greenhouse (admittedly not airtight) that gave Ward the idea for setting up his aquarium in 1842 was never made clear, either by him or his encomiastical son. At any rate, the father did not publish an account of his work until 1852. Ward was apparently indirectly responsible for the first public aquarium. His tank inspired a Mr. Bowerbank to set up one of his own, and this in turn gave David W. Mitchell, Secretary of the Zoological Society of London, the idea of an exhibit made up of a series of such tanks. This took form in Regent's Park as the Fish-house, which was opened to the public in the spring of 1853 and consisted



New York Zoological Society photo by Sam Dunton

▲ SWORDTAIL (female above and male below). One of the most popular of the small, tropical, fresh-water fishes kept as pets throughout the world

solely of a number of standing aquaria, some with fresh, some with salt water, housed in a conservatory-like building.

Judging from the remarks of the times, the exhibition was a tremendous success. Moreover, it so stimulated the hobby of keeping fishes as pets that it became more or less of a craze. Dealers in tanks and aquatic plants and animals established themselves in London and Edinburgh. Prices for a ready-made home aquarium ranged from two shillings to ten pounds. The experience of one J. Paul was perhaps typical: "I saw the aquarium first at the Regent's Park Gardens, then in a shop-window in the City Road, and then—everywhere; and I at once determined to be the happy possessor of a tank. Alas," he continued, somewhat ruefully, "I knew not the penalty attendant on this worship of Neptune."

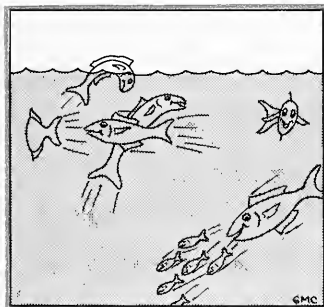
Punch gently poked fun at the fancy in its issue of December 13, 1856:

*Oh, come with me,  
And you shall see  
My beautiful Aquarium;  
Or if that word  
You call absurd,  
We'll say instead Vivarium.*

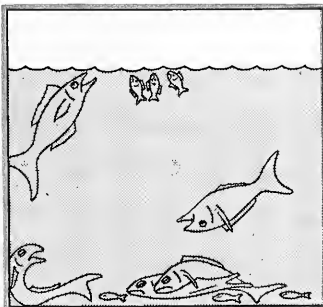
*'Tis a glass case,  
In fluid space,  
Where, over pebbles weedy,  
Small fishes play:  
Now do not say  
You think they must be seedy . . .*

*My Dicky sings,  
And claps his wings,  
I know that what he wishes  
Is to escape  
His cage, and scrape  
Acquaintance with the fishes.*

*Now tell me, do,  
Suppose that you  
Your mode of life could vary;  
Which would you like?  
To be my Pike?  
Or to be my Canary?*



A tank readily gets enough energy creating oxygen for its fishes from the air



The water in a tank of fishes cannot easily get rid of excessive and deadly carbon dioxide

By 1858, at least nine books on the keeping of home aquaria had been published in London, and an encyclopaedia of 1854 included an article on the subject. In all of these and in various newspaper and magazine articles, too, the idea of balance between the aquarium's plants and animals was stressed. Our myth was now firmly fixed in common knowledge; a host of amateur aquarists practiced its precepts



New York Zoological Society photo by Sam Duntun

▲ A NATURAL SETTING for jewel-like Sumatra barbs is provided by *Sagittaria* (foreground), water sprite (right and left), and a sword plant (rear)

daily, and they and their friends saw living proof of it each time they looked into a tank.

There was living disproof of it to be seen also, but this was either overlooked or reasoned away. For many years previous, fishes had been successfully maintained in bowls and tanks without any plant life in their water. How did that fit into the scheme? In 1956, Shirley Hibberd expressed the view taken by aquarists on this matter: "*The Philosophy of the Aquarium must be clearly understood . . . It is a self-supporting, self-renovating collection, in which the various influences of animal and vegetable life balance each other and maintain within the vessel a correspondence of action which preserves the whole. A mere globe of fish is not an aquarium in the sense here indicated; because to preserve the fish for any length of time, the water must be frequently changed. . . .*"

And yet hundreds of aquarists before and since have kept fish in tanks without plants and without changing the water for months on end. Hibberd himself kept a tank of goldfish with no plants and without changing the water for seven years. He explained this by attributing the oxygenation of the water to microscopic and algal growths. He wrote that, although it may take some time for a tank "to become richly clothed with suitable oxygen makers, some supply of oxygen is secured from the very first, for I have seen ciliated spores and be-

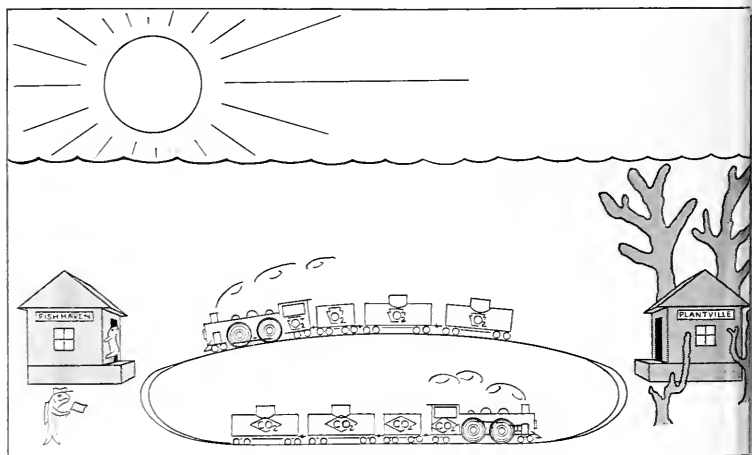
ginnings of genuine vegetable deposits within a few hours of the first furnishing of a tank. Hence it was that . . . I did not hesitate to introduce the fishes as soon as the tank was furnished, without waiting for the full development of the microscopic forest, for I knew that before the fishes exhausted the oxygen in the fresh river water, there would be the beginning of a new supply for them, and there was never any distress through that procedure." Since fish can live in a newly set up tank without any apparent plants at all—either introduced or grown *in situ*—there must be enough unseen ones present to oxygenate the water, else the fish would die! The reasoning was fal-

lacious, but somehow the facts had to be made to fit the belief.

In addition, it has always been well known that at night or on dull days plants consume oxygen and give off carbon dioxide just as animals do. How did fish survive such periods in an aquarium? Was it by breathing oxygen that had been stored up in the water while the plants were producing it? No aquarist ever said so, but this was implied in some of their works. A little thought on the properties of oxygen dissolved in water would have shown this to be impossible.

Similar inconsistencies can be traced right down through the books and articles written today on the care of tropical fish. Only one popular writer on the subject has recognized this—C. W. Coates in his weekly column, "Tropical Fish and Home Aquaria," appearing in *The New York Sun* each Friday. I have seen an aquarist hotly maintain that plants are indispensable in an aquarium, while literally under his nose was a tankful of his own cichlid fish—notorious plant-rooters—living contentedly without a sprig of green. Some concepts are simply too good to discard, even if they are untrue; the balanced aquarium is one of them.

Proof that the balanced aquarium existed only in the minds of its devotees and an uncritical public



In daylight, plants help fishes in the same tank by using up carbon dioxide. The fishes also help the plants by providing carbon dioxide



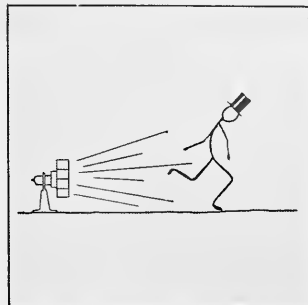
was published in *Copeia* in 1931 by Charles M. Breder, Jr., at that time Research Associate at the old New York Aquarium in Battery Park. His proof that "the production of oxygen by the photosynthesis of plants in open balanced aquaria contributes little, if any, to that consumed by the animal life therein" was obtained most directly—simply by *measuring* the amount of oxygen present under different conditions. No one had ever bothered to do this before, and Breder found that as far as oxygen was concerned, an "over or under saturation returns with extreme rapidity to equilibria" with the air above the water. In other words the water is practically never under or oversaturated with dissolved oxygen. As soon as the slightest deficiency in oxygen exists in a tank, oxygen from the atmosphere passes into solution to make it up. Similarly, if an excess is produced by plants under the influence of bright light, this quickly passes off into the air.

In fact, one might say: just try to keep oxygen out! Research workers in fish physiology sometimes want to determine exactly how much oxygen a fish consumes. To do this, they must measure the oxygen in a *sealed* container of water before and after a fish has lived in it. The problem is to get

a seal that will keep out the atmospheric oxygen during the course of the experiment. Even one and one-half inches of heavy mineral oil, floated on the top of an aquarium's water, will not entirely keep out atmospheric oxygen from above, when the fish begin to use up the gas already dissolved in the water below. Scientists have had to design some complicated apparatus to circumvent this difficulty.

Despite this omnipresence of oxygen, every aquarist has at one time or another seen his fish gather at the surface of their tank, "gaping." What makes them come to the top, breathing rapidly, seeming to be in some sort of respiratory distress? Not a lack of oxygen but an excess of carbon dioxide. Compared with oxygen, this gas passes from the water into the air and from the atmosphere into solution much more sluggishly. Consequently, when an excess amount of it appears in an aquarium, it takes an appreciable length of time for it to pass off. On the other hand, Dr. Breder found that in tanks where plants were actively engaged in photosynthesis—building up carbohydrates out of water and carbon dioxide and giving off oxygen—the carbon dioxide remained far below its equilibrium level with the atmosphere for extended periods.

Plants, then, can and do make

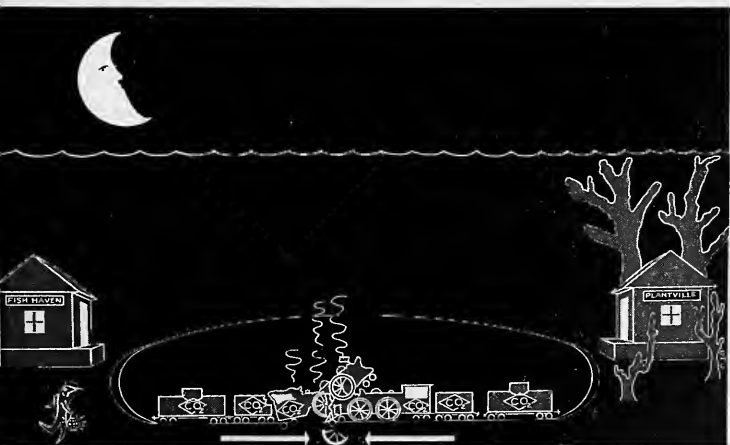


Aerating a tank or stirring the water does not ordinarily help the fish with oxygen, but it does hasten removal of poisonous carbon dioxide

an aquarium more habitable for aquatic animals by using up the carbon dioxide that the latter produce—carbon dioxide which, as Dr. Breder put it, is "the limiting factor as regards the respiratory gases." If plants were at work all the time, a tank containing them could support more animals than one without. But at night or on dark days, when they cannot carry on photosynthesis, plants breathe like animals, adding their share of suffocating carbon dioxide to the water. They breathe, of course, in bright light, too, but then their respiration is far outweighed by their photosynthetic activity, and they consume far more carbon dioxide than they produce. Without bright light, however, the presence of plants in a tank actually lessens the number of fish that tank will support. Contrary to general belief, putting plants into an aquarium does not make it possible to keep more fish in it.

It has long been known that carbon dioxide in excess kills fish or man. It has an exaggerated reaction on the blood of many fishes, called the Bohr Effect, after the physiologist, Christian Bohr. Relatively small amounts of carbon dioxide increase the efficiency with which the blood of some fishes can deliver oxygen to the tissues; but at the same time, it decreases the ability of the blood to take on oxygen at the gills. The fish thus uses up what it has and cannot replace it. This can be demonstrated by

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At night, or in insufficient light, the plants actually restrict the fish population by adding to the carbon dioxide

# THE POLYPHEMUS

By ARTHUR C. PARSONS

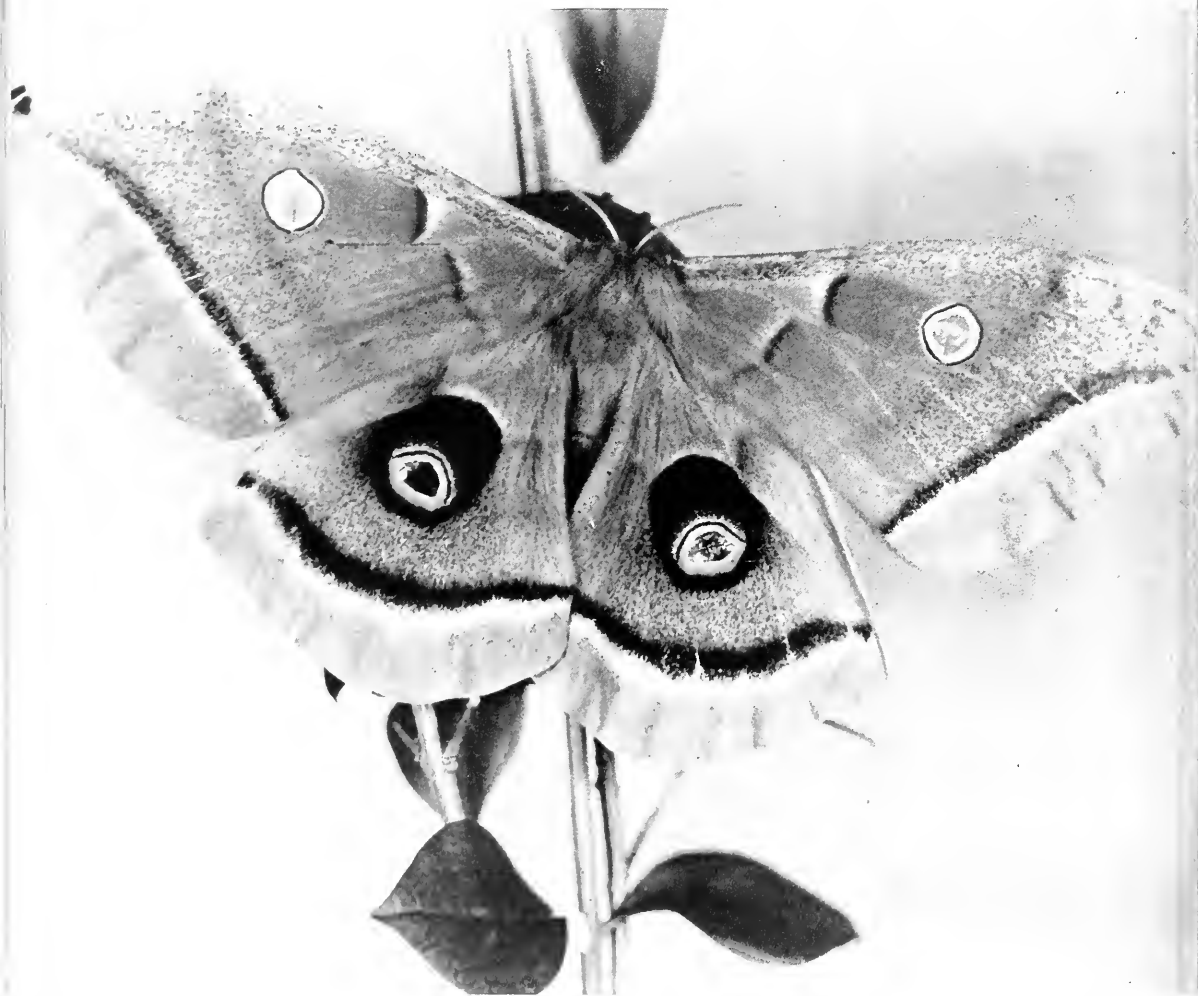
*All photographs by the author*

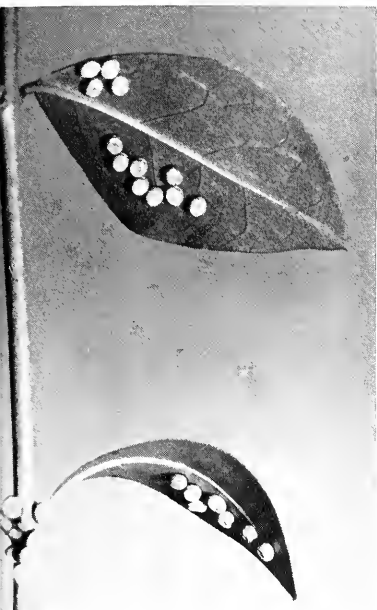
## *Moth*

From egg to winged adult, this beautiful insect provides an interesting study in transformation that can be observed in all parts of the United States

▼ THIS FEMALE POLYPHEMUS emerged from the cocoon about one-half hour ago. She will not eat during the rest of her life but will lay 300 or more eggs

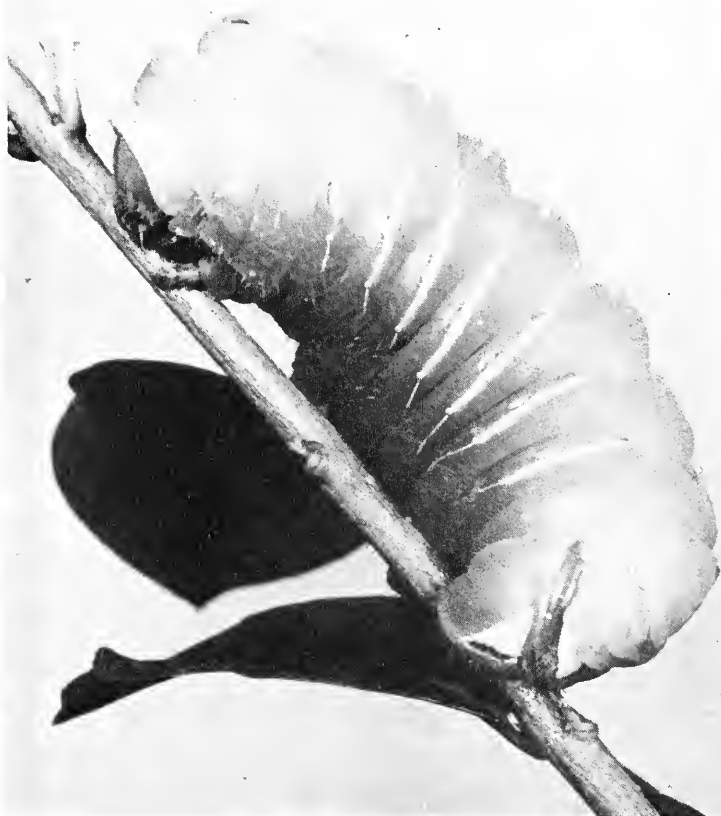
LAST October a pale green caterpillar, three inches long and as thick as one's thumb, climbed down from the branches of the privet hedge bordering the terrace and crawled rapidly along the cement walk to the porch steps. There





▲ SHE LAYS THE EGGS on leaves upon which the caterpillars will feed. They hatch within ten days. Fewer than five per cent will probably survive to maturity

► THE CATERPILLAR, pale green with red dots, molts several times during the summer and becomes about three inches long and as thick as one's thumb



he paused for a moment, apparently trying to decide whether to mount the barrier or go around it.

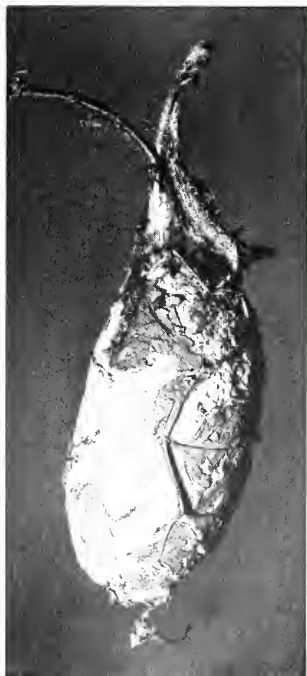
While he was trying to make up his mind, I picked him up and put him in a box until I could get my camera and tripod. Then I placed him on a branch of the hedge, arranged a piece of gray cardboard behind him, and tried to take his picture; but he was not the most willing subject in the world. Like most insects, he insisted on moving out of focus every time I was almost ready to snap the shutter, but I did manage to make three exposures after a half hour of patient work. I wished to make some Kodachromes of him the following day, so I placed the caterpillar in a breeding cage supplied with twigs of privet, barberry, wild black cherry, and oak so that he would have his choice of food.

THE POLYPHEMUS MOTH

Apparently the caterpillar had eaten enough food during the preceding months, for when I returned from work the next afternoon, he was no longer there. Instead there was a compact, silken cocoon, two inches long and nearly an inch in diameter, lying in the leaves on the bottom of the cage.

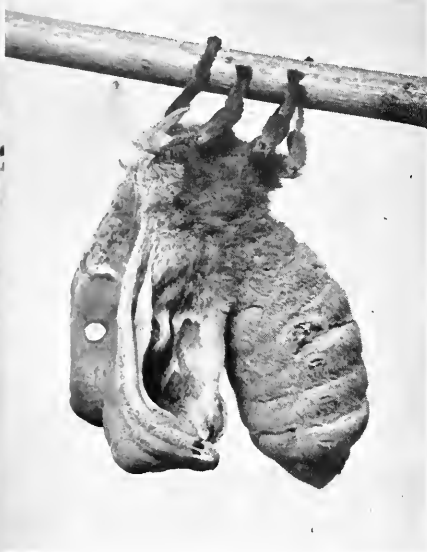
The cage was put outdoors for the winter so that the moth would not emerge at the wrong time or lack sufficient moisture. Moths will emerge during the winter if the cocoons are kept inside, but care must be taken to moisten them regularly to prevent them from drying up. Polyphemus cocoons es-

► THE THREE-INCH CATERPILLAR spins a two-inch silken cocoon for itself. This one was on a barberry twig



► THE WINGS unfold and lengthen as fluids from the body are pumped into them. The body grows smaller as the wings enlarge

▼ HALF A YEAR LATER, in May or June, the moth emerges. At first the wings are wrapped around the body and appear small in proportion to it



► WHEN THEY have reached full length, the wings begin to widen. About 20 minutes are required for them to become fully expanded



pecially need moisture to ensure perfect insects.

On the 15th of last June, a scratching sound could be heard issuing from the inside of the cocoon, a certain indication that the moth was preparing to emerge. A damp spot appeared at one end of the cocoon, for the moth emits a secretion that softens the silk threads, enabling it to escape more easily. Then a tiny hole appeared in the center of the spot. This grew larger so that the moth was able to get a pair of legs through, and then the insect pulled itself out quickly as if glad to be free after nearly ten months of imprisonment. The *Polyphemus* is especially oblig-

ing in letting you know in advance that it is ready to appear; others, such as the *Cecropia* and *Promethea*, come forth quickly and silently with no scratching sounds to warn you.

Any moth just emerging from the cocoon is a sorry spectacle. The *Cecropia* and *Promethea* have their wings wrapped around their bodies and bear little resemblance to the beautiful insects they will be an hour later, but I believe that the *Polyphemus* is the most bedraggled of all. The body is wet and huge, and the wings are stubs not much larger than a thumbnail. The antennae look natural, but they are so large that they make the poor moth seem even smaller. However, you will see a great change in a matter of minutes. The moth immediately climbs out on the nearest branch, in this case a privet twig. It hangs with body down and begins to vibrate both body and wings. The fluids in the body are pumped into the wings, which at once begin to lengthen and unfold, as can be seen in the illustrations. You can actually see the veins ap-

pear and watch the unfolding of the wings. As the latter become wider and longer the body decreases in size. At the end of twenty minutes the wings have attained full size, but the moth is not yet ready to fly. For an hour or more the insect slowly opens and closes its wings in order to dry and harden them. This particular specimen crawled out of the cocoon a few minutes past four in the afternoon but made no effort to fly until after six o'clock.

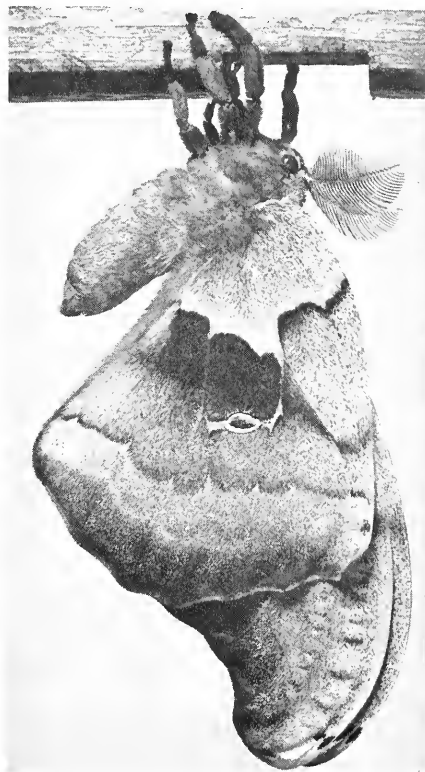
During the winter I had found another cocoon hanging in a neighbor's barberry hedge. I placed it in the cage with the other one, and the moths emerged one day apart. Fortunately one was a male and the other a female, so I was able to photograph both to show the difference in the size of the body and the antennae. The coloring is the same in both, but the male is not so large as the female and has a more slender body and much larger antennae. The latter are so large that they resemble small ferns.

The female deposited 326 eggs on the leaves and branches placed



IN ORDER to hasten drying, the moth slowly opens and closes her wings. A few minutes after this picture was taken, she made her first clumsy flight

COMPARE THE BROAD ANTENNAE of this male Polyphemus with those of the female. Both moths are beautiful creatures. Wherever a pair find each other, the yearly cycle of eggs, caterpillar, cocoon, and winged adult may be renewed



in the cage. They hatched in a few days, and the tiny caterpillars at once began feeding. The food plants are many—I have seen the caterpillars on oak, birch, maple, apple, barberry, and privet. Normally, very few of these caterpillars would survive to spin cocoons in the fall, for birds, animals, poisonous sprays, and ichneumon fly parasites exact a large toll. There are never enough of the caterpillars to do any serious damage to our shade or forest trees.

The Polyphemus moth gets its name from the large "eye" in each lower wing, because in classical mythology Polyphemus was one of the one-eyed Cyclops. These yel-

low, blue-ringed "eyes" with a brown pupil can be fearsome-looking objects to a predatory bird, for they resemble the fierce eyes of an owl when seen close up. Early one morning I saw a robin swoop down upon a Polyphemus that was resting on a post, but when the bird came within a few inches of his intended prey he suddenly put on the brakes and departed hurriedly. Evidently he did not like the appearance of the "eyes." Other birds are not so easily frightened, however, for I have seen many pairs of Polyphemus wings lying on the ground at a pump station in the woods. The moths had been at-

tracted by the bright lights, had remained there until dawn overtook them, and the birds had descended upon them.

The caterpillar does all of the feeding, for the moth has no mouth parts and its life span is short. The Polyphemus lives only long enough to mate and deposit her eggs on suitable food plants. Then she dies, her mission accomplished. The caterpillar lives four months, the moth about that many days.

From the days of Aristotle almost down to our own time, people pondered over the mystery of how eels reproduce their kind, but the perplexing problem was finally solved

By WILLY LEY

THE two most important things about the fish *Anguilla*, the common eel of rivers and lakes, were put into writing some 300 years ago by the famous Izaak Walton, in his equally famous book *The Compleat Angler*.

"It is agreed by most men, that the Eel is a most dainty fish; the Romans have esteemed her the Helena of their feasts; and some the queen of palate pleasure. But most men differ about their breeding: some say they breed by generation, as other fish do; and others, that they breed, as some worms do, of mud."

The first of these two sentences may astonish some American readers, since the eel, probably because

of its serpentine shape, is not valued highly as a food fish on this side of the Atlantic. Europeans may have their differences, but they are in full agreement that the eel is superb as a food fish, provided it has been well prepared. But there are some differences concerning the meaning of "well prepared." In the northern European countries, especially along the seashore, smoked eel is preferred, while farther inland it is either boiled with dill or served cold in aspic. The fishermen along the shores of the Baltic go everybody else one better; they smoke the eel first and then fry it in butter. The fact that the eel is not a rare fish may have added to its popularity. Generally, where eels

are found at all, they occur in rather large, sometimes incredible, numbers.

So much for Izaak Walton's first statement. As for the second—that is a long and complicated story, full of surprises.

Since the oldest times, fishermen have found roe or milt in their fish when the season was right. But in the case of the eel, there seemed to be no such season. Nobody could truthfully claim to have seen eel roe, and Aristotle, some 2000 years ago, summed up popular experience when he stated that "the eel has no sex, no eggs, no semen and originates from the entrails of the sea."

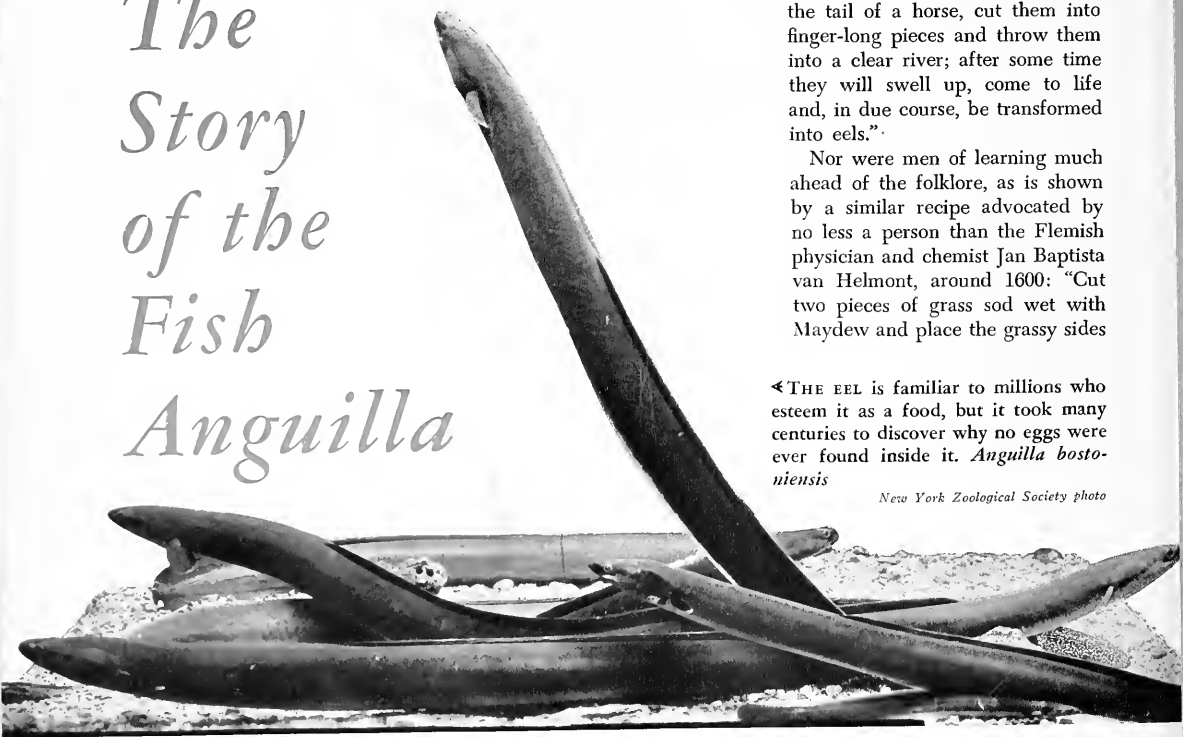
Since the problem of the eel's spawning was such a deep mystery and since the eel, on the other hand, was such a common fish, it is not surprising that various superstitions sprang up, taking deep root in the course of time. German folklore, recorded in the sixteenth century but probably centuries older, provided a simple recipe for increasing the supply of eels in a given locality: "Take hairs from the tail of a horse, cut them into finger-long pieces and throw them into a clear river; after some time they will swell up, come to life and, in due course, be transformed into eels."

Nor were men of learning much ahead of the folklore, as is shown by a similar recipe advocated by no less a person than the Flemish physician and chemist Jan Baptista van Helmont, around 1600: "Cut two pieces of grass sod wet with Maydew and place the grassy sides

◀THE EEL is familiar to millions who esteem it as a food, but it took many centuries to discover why no eggs were ever found inside it. *Anguilla bostoniensis*

New York Zoological Society photo

# The Story of the Fish *Anguilla*





together, then put it into the rays of the Spring sun, and after a few hours you'll find that a large number of small eels have been generated."

Propagation being so simple, it posed a major puzzle. Why, for example, were the Rhine and all its tributaries swarming with eels while the Danube and its tributaries were devoid of them? Dr. Konrad Gesner of Zurich, the great Swiss zoologist, decided that the water of the Danube must be "inimical" to eels and stated that eels thrown into the Danube would soon die. This explanation was probably accepted by his contemporaries; and it is safe to say that they would have disbelieved the real explanation had anybody been able to tell it.

But in spite of these fanciful ideas—that young eels originated from Maydew in moist grass and that pieces of horsehair would come to life—the weight of practical experience tended to indicate that eels gave birth to live young. Every once in a while an eel "full of tiny eels looking like twine" was caught, apparently furnishing visual proof. Unfortunately, these tiny "eels" were neither eels, nor fish, nor even vertebrates. They were intestinal parasites—worms (mostly nematodes) which infest all kinds of fishes. If they were found inside a pike or carp, nobody was puzzled for a minute; but if found inside an eel, they were baby eels.

While fishermen and zoologists living inland remained hopelessly confused, their confreres living near the seashore had some additional, and apparently quite simple, evidence. Every autumn more or less fully grown eels were caught in increasing numbers along a stream, and it could be inferred that they were migrating to the sea. In spring swarms of small three-inch eels left the sea and gradually worked their way upstream. Because they were transparent at first, these young eels were called "glass-eels" along the European continental coast. British fishermen referred to them as elvers. They soon lost their transparency and became practically black.

After notes were carefully compared, the question seemed nicely settled about 100 years ago. Some well-known fishes like salmon, shad, and sturgeon went upriver for spawning but otherwise were not really river fish. The eel reversed the process: it was a fresh-water fish but went to sea for spawning. That was true for *Anguilla anguilla*, the European eel, and also for *Anguilla chrysops*, the American eel. And the Danube river system did not harbor eels because the Danube empties into the Black Sea, where eels probably could not breed. It was not the water of the river that was "inimical"; it was that of the sea beyond the mouth of that river.

This is what natural history books, beginning about 1830, presented as the facts of the case. They still said the same thing in 1880. And still in 1900 and in 1905. But meanwhile a kind of quiet revolution had taken place, which went unnoticed for some time.

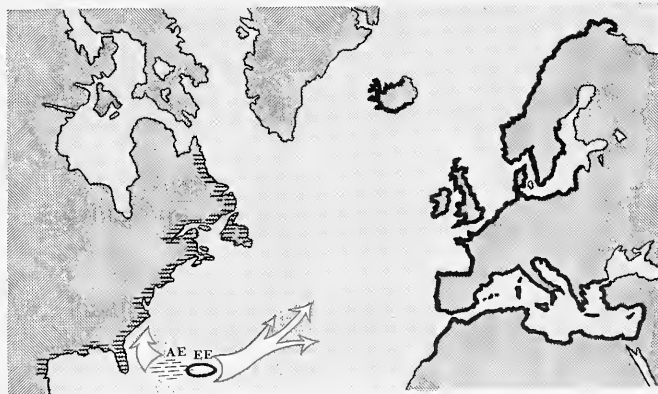
It had begun in 1856. During that year a naturalist, a certain Doctor Kaup, had caught a very curious little salt-water fish. It was interesting mainly because of its appearance. If you had some in a salt-water aquarium, you would think at first that the aquarium was empty. Looking more closely, you would see a few pairs of tiny, dark eyes apparently swimming around



After Johannes Schmidt

▲ SIX STAGES in the transformation from *Leptocephalus brevirostris* (at top), found far out in the Atlantic, to the completely changed young eel found near the coast (bottom). (About  $\frac{3}{4}$  actual size)

by themselves. Intent watching would disclose watery shades trailing the eyes. Out of water, the fish would look like a laurel leaf made of flexible glass, thin and fragile and transparent. You could place the fish on the page of a newspaper



▲ BREEDING AREAS of fresh-water eels in the Sargasso Sea in relation to their destinations in America and Europe. It is not clearly understood why one kind goes west, the other east. Under normal conditions they do not seem to intermingle

or a book and read the type through its body without difficulty.

Doctor Kaup did the usual thing. He searched the literature for an earlier description of the fish and, finding none, described it himself. Following scientific custom, he also selected a name. It was *Leptocephalus brevirostris*.

And that was that for some time. Another fish had been discovered, nobody knew whether it was rare or common. But two Italian ichthyologists, Grassi and Calandruccio, had read Doctor Kaup's description and had decided they would investigate leptocephalus a little more, if and when they found the time. They later admitted that they would not have waited so long had they known what they were to discover. But they did not know, and there was always other, more pressing work. The investigation of leptocephalus was postponed from year to year. Meanwhile, they had at least learned that the fish was not rare; if needed, specimens could be obtained from Messina.

The long postponed investigation began in 1895. At first the procedure was routine. The fish were caught near Messina, and an aquarium to please the inhabitants of the local waters was prepared. Several leptocephali were put into it, and Grassi and Calandruccio began their work by trying to find out what leptocephalus would eat. Many an investigation of living animals has come to an end because of feeding problems. But there was no trouble on that score; these little fish ate most of the food that Grassi and Calandruccio expected them to eat. They ate and swam around and appeared to be in good health—from what you could see of them.

But they shrank! The largest of the leptocephali had been 75 millimeters (3 inches) long when caught. It lost a full 10 millimeters while under observation. It also shrank in the other direction, becoming narrower and losing its typical leaf shape. And then, with suddenness, leptocephalus became an elver, a "glass-eel"!

When they had recovered from their surprise, Grassi and Calandruccio announced that Doctor

Kaup's genus *Leptocephalus* was not valid. *Leptocephalus* was merely a kind of larval stage of the eel. Upon passing through adolescence to maturity, the eel returned to the sea unless prevented from doing so. The mature eel, the scientists concluded, laid its eggs at the bottom of the sea and presumably died, since nobody ever saw large eels returning upriver. The eggs hatched into the larval stage (Doctor Kaup's mistaken *Leptocephalus*) and stayed near the bottom until they were either changed or about to change into the elver stage. The elvers then swam to water of less and less salinity and finally entered the rivers.

Grassi and Calandruccio also had an explanation for the rarity of the leptocephalus stage. It was rare, they said, because the larvae stayed near the sea bottom. It was just a lucky break that specimens could be procured from the Strait of Messina, where currents often swept deep-water forms to the surface. Thus, modestly ascribing their own success to their advantageous position, the two Italian scientists concluded their report, which constituted one of the great contributions to science.

At long last the mystery of the eel's spawning and breeding had been solved.

Still, this was not the end of the story. The scene shifted once more, to another year, another sea, and another expert. The year was 1904; the sea, the North Atlantic between Iceland and the Faeroe Islands; the expert, the Danish biologist Dr. Johannes Schmidt, working for the Royal Ministry of Fisheries on board the small Danish steamer "Thor."

From the "Thor" Dr. Johannes Schmidt caught, by means of a surface net, one of the transparent laurel leaves that the two Italian scientists had made so famous. Beyond doubt it was *Leptocephalus brevirostris*, and it was as long as the longest specimens from Messina, namely three inches. Doctor Schmidt was mildly elated. A leptocephalus had come to the surface for some unknown but probably interesting reason.

# Tooth of an

## HOW SMALL IS THE SMALLEST?

ON previous fossil hunting expeditions we had been interested in big prehistoric animals—dinosaurs—so it is all the more remarkable that Mrs. Hunter should have found this little tooth.

In 1937, we were thirteen miles north of Eastend, Saskatchewan, in an area known as Cypress Hills. The bare exposures at the head of a little river called Calf Creek had been quite productive. In all, we were able to find some 2000 separate fossils at this location. But in many ways this smallest specimen is the most interesting, not only because of its size and its ancient story but because of the adventures it went through after its discovery.

We had been digging in the exposed slopes of a low hill whose rocks had been laid down in the Oligocene. Mrs. Hunter was almost ready to go back to camp for the day, when I heard her call out. From her actions you might have supposed that she was trying to take a splinter out of her hand. When I saw what she had, I could scarcely believe my eyes. It was incredible that anyone could have eyes so sharp as to see this tiny tooth amid the jumble of rocks and dirt.\*

A few months later another one was caught, this time off the Irish coast and again at the surface. Now it began to look as if Grassi and Calandruccio had not spoken the final word in the story of the eel. Either their findings applied to Mediterranean eel larvae only, or they had unknowingly generalized somewhere, taking a reasonable assumption as a proven fact and arriving at a misleading conclusion.

# Ancient Field Mouse

The tiny object behind the magnifying glass is a molar from an animal that lived 22 to 35 million years ago.

You may well ask how it was ever discovered

By FENLEY HUNTER

We carefully wrapped the tooth and put it into a matchbox. Back in Garden City some weeks later, some of our scientific friends were at the house, and we brought the tooth out. The celebrated paleontologist Dr. Walter Granger, veteran of many fossil hunting expeditions, was among the guests, and we felt he might find the tooth interesting. We handed it to him on a crumpled piece of tissue paper, and he walked to the light to examine it.

"There is nothing here except cigarette ashes!" he said. We all looked and saw that he was right. The tooth was gone. Dr. Granger felt terrible, of course, that the tooth had apparently disappeared while in his possession. A long search on hands and knees followed, but in the nap of the carpet we could not find anything so small. We searched for hours. Mrs. Hunter kept saying that the tooth had not been difficult to find in the first place and that it ought not to be now. However that may be,

\*For further illustration of Mrs. Hunter's eyesight, the reader is reminded that it was she who noticed the Frankinia blooms in an Audubon painting dated some 40 years after the Frankinia was supposed to have become extinct in the wild. (NATURAL HISTORY Magazine, October, 1947, page 337.)

Doctor Schmidt reported to the Danish Government and was given the assignment to discover more about eels, elvers, and leptocephali.

Having supplied himself with all available information, he sailed on the "Thor" and told the captain how the job might be tackled. The specimens caught by him so far had been three inches long—the size at which they should be ready to begin the



AMNH photos

▲ UNDER THE LENS, it can easily be recognized as a tooth. The animal to which it belonged was never found, but from the configuration of its cusps, the tooth can be identified as the second molar of one of the oldest known field mice

the tooth was still gone when the evening ended.

Mrs. Hunter began the search again bright and early the next morning, and at length she rediscovered the tooth in the upholstery of the divan. Of course, Dr. Granger was greatly relieved when we telephoned him.

So this little tooth is not only one of the littlest fossils ever found but perhaps the only one that had to be found twice. Dr. George Gaylord Simpson, of the American Museum, says it is a second molar and

change into elvers, assuming that the Atlantic variety behaved like that of the Mediterranean. Obviously the larvae had to be smaller before they grew to a length of three inches. Where would the smaller ones be? Grassi and Calandruccio had implied, and even stated, that with leptocephalus it was a case of "the deeper, the smaller." Doctor Schmidt's own experience had already shown that

that it probably came from the jaw of one of the oldest known field mice (*Eumys*). In the Oligocene (22 to 35 million years ago), when this little animal lived, field mice were making their debut into history.

The tooth is now safe under a glass globe. Sometimes I look at it on the mantelpiece before going to bed, because I like to dream about what the world must have been like when that little creature was munching seeds of Oligocene vegetation.

this was not necessarily the case off the coast of Ireland. How about the assumption "the farther out, the smaller?"

A nautical chart of Western Europe shows a line where the depth of the sea is 3000 feet; sailors refer to it as the 500-fathom line. West of this line is the deep Atlantic; east of it the shallow sea, which is a flooded section of the continental land mass. Schmidt found that the

Continued on page 95

NATIVE to our American Southwest is one of the strangest lizards in the world—the “horned toad.” It was in central Texas that we had our first opportunity to watch this unusual creature, and to develop a fondness for it such as most people feel for robins, lady bugs, and chipmunks. Although able to scamper over the ground at the speed of a mouse, the horned toad seldom resists capture. Some horned toads, when taken into the hand, puff themselves up with air so that their sides extend in a smooth curve from forelegs to hind, and their belly surfaces bulge outward like a pneumatic pillow. Others deflate themselves to an altogether astonishing extent; and exploring fingers fail to find much, if any, indication of internal organs between the rough-scaled back of the creature and its very concave abdomen. Usually they keep their little black eyes wide open, yet try as you may, you can see no pupil—the cornea and iris are too dark. Occasionally a horned toad is less

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# WE SHADOWED The Horned Toad

The toad that is not a toad and can squirt blood from its eyes makes an exciting fellow passenger on a transcontinental tour

By LORUS J. and MARGERY J. MILNE

*Department of Zoology, University of New Hampshire*

*All photographs by the authors*

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trusting, especially if you touch its back or horns; it may clamp shut not only its eyes but also its nostrils. The latter close like hot-air registers, with internal, scaly “dampers” that exclude the outside world.

On the dry ground, horned toads

scurry from place to place in short dashes, interspersed with long periods of standing still, head and shoulders as far above the ground as the forelegs can hold them, eyes alert for movement of any insect near by. Their vision is keen and binocular, but they seldom attempt to chase down their prey as do many other lizards. Instead, they wait until the insect is nearer, or creep up to it slowly.

You will find much amusement in watching horned toads that have recognized some prospective victim. The first sign of awareness reminds one of a cat watching a mouse or a bird. The lizard’s spiny tail curls jerkily from side to side with excitement. When the prey is almost within reach, the little reptile takes a quick step forward, and faster than the eye can follow, a pink tongue is extended. In a lizard, this similarity to a true toad or frog is remarkable. Neatly the tongue flicks the bug into the horned toad’s throat. Commonly the food is ants, but other insects are taken whenever possible. Some-



◀WITH SHARP HORNS and spines, curved claws and strong legs, the horned toad seems well armored. Yet the inside of its digestive tract is apparently the only part of it that can stand the bites of ants. Its spiny exterior is too sensitive

times large grasshoppers allow themselves to be caught. Several quick swallows are required after the first sudden bite, and the lizard throws its head and shoulders into a perfect frenzy of motion to keep the prey from getting crosswise in its ample, V-shaped mouth. The horned toad backs up, jerking its head from side to side and pressing it against the ground. In a few seconds the grasshopper's legs and wing tips are the only visible parts, and the lizard's ludicrous attitude might easily be interpreted as indicating surprise at its own success.

A request for photographs started us on our most recent hunt for horned toads. We were planning a trip west, and the suggested project gave us a good excuse to take the southern route through Texas. We knew from previous experience that although these lizards are common throughout much of the Lone Star State, the natives know them as "little ol' horn frogs." The reptile is just one of the three "frogs" there—a vagary of language that puzzles a naturalist on a first trip. "Toad frogs" are toads—warty and phlegmatic. "Green frogs" are the wildly jumping sort that the easterner expects. Both of these Texas creatures lose their tails when they leave the tadpole stage. But the "horn frog" is the lizard of the three, an animal that wears its spiny tail for life and never has a swimming stage. It is far more completely adapted to existence in the arid Southwest than true toads or frogs and has a strange but obvious claim to man's friendly understanding. It is queer that we have no better name for these harmless reptiles (of which there are about a dozen species) without employing the scientists' term *Phrynosoma*. And a graduate of Texas



▲ HORNED TOADS shed their skins periodically. Ridding the lips and eyes of the old skin is a complicated business that requires a special mechanism. Muscular cuffs around the jugular veins stop the return of blood from the head and cause the lips and eyes to bulge outward, so that the old skin tears away and falls free. The same circulatory mechanism sometimes causes the horned toad to squirt jets of blood from its eyes

Christian University at Fort Worth would be rightly indignant if asked about the *Phrynosoma* on his alma mater's coat-of-arms! So would a member of the institution's football team, which is roused to exert itself by tunes from the "horn frog band."

Less than five miles into Texas from the Oklahoma border, we spotted a horned toad at the edge of the pavement. We were overjoyed to recognize our old friend while we were traveling 60 miles an hour, and when we stopped and tickled its chest, it blew itself into a firm, flat, rough little balloon. But we wanted a photograph showing

the lizard along a flower-studded roadside, engaged in some natural occupation such as feeding. Horned toads, we knew, ate ants—preferably the large red Agricultural Ant, whose broad mounds disfigured the fields we had passed in Oklahoma. All through the drier parts of the West the horned toads are regarded as beneficial animals because of the numbers of these damaging insects they engulf. Yet try as we might, we could find no sign of an ant along the highway border. More horned toads but no insects in the hot, dry air or on the sun-baked ground. Upon what could the lizards be feeding? In the blazing



light we settled down to watch one. The lizard soon forgot us. Along came a beetle, which vanished as it passed the toad. A robber fly lit on one of the flowers, then crept down the stalk on some strange errand. The horned toad got it, too. We took pictures from every angle, then carried the collection of placid reptiles along for further observation.

In the car, the sun poured in on the lizards. Soon they opened their mouths and began to pant! We moved them to a shadier spot, and they closed their mouths, relaxed, and went to sleep. Would that so simple a remedy could relieve our perspiring discomfort!

Across the Texas Panhandle and into New Mexico we played the part of Hawkshaw, sneaking up on every horned toad we could find, shadowing its every move, with cameras ready to record the details of its private life. Then suddenly we got a surprise. The horned toad in front of us was different from any we had seen before. Instead of the tan to golden color, this one was brown with ashy flecks like spattered shoe polish. Gone were the eight brown marks down the back, each edged with a still darker line. In their place was an orange-yellow band with four extensions on each side. And whereas the familiar horned toad in Texas always appears to have had its back scales stroked the wrong way, the upper surface of this one was comparatively smooth. In astonishment we picked up the new horned toad. Where were its horns? Instead of the two long, glossy, upward-directed spikes of the Texas toad, it had short, obtuse bumps of brown spotted with gray. The side horns were brief, too, yet this was obviously a horned toad. We compared its color scheme with the more eastern form. Yes, it blended far more perfectly with the gray desert sand and matched also the brownish rock near by. But when we placed the New Mexican form on a bright red block of petrified wood, the color combination was rich beyond expectation.

In Albuquerque, the Milne family (toads and selves) paid a visit to

the University of New Mexico and there consulted the biology faculty and also a few reference books. The toads submitted both to fondling and to sensitive fingers while the professors tried to decide whether we had found males or females. Only horned toads seem to know the answer to this question,

and the matter was left unsettled. But our interest in the lizards received an unexpected lift at this conference. We learned that similar horned toads in captivity at the University had given birth to living young. Not just one, or two, or ten—but a score or more! And the professors had been trying to tell by



▲ PRICKLY PEAR CACTUS and spiny horned toad are common on the same arid lands. The lizard has been called the "cactus of the animal kingdom." But on a hot day, when the plant must stand high temperatures, the horned toad seeks shade periodically or digs into the soil where the sun's energy cannot easily reach it



touch whether our specimens contained little lumps that might be unborn toadlets. More than ever we became determined to keep the lizards with us on the trip, to feed them if possible, and to watch for those unfamiliar offspring. We had so many adults already that *all* of them could hardly be males.

Living with an assortment of horned toads gave us excellent opportunities to learn more about them. And as we gained skill in recognizing these camouflaged lizards against their various types of backgrounds, we came to see not only adults but partly grown individuals almost everywhere we went. We fed them all kinds of food and found just one generalization to be true. Horned toads are aware of potential prey only when the prey is in motion. Dr. Raymond Ditmars, in his *Reptile Book*, gave as his experience that "horned toads will not eat earthworms." Ours did. Three-inch night crawlers seemed to puzzle the lizards for some time. Recognizing the head end appeared to be the difficulty, since this is the part invariably seized. But once a decision was reached, the worm went down the toad's throat just as easily as any grasshopper. Nor was the reptile's expression any less ridiculous when only a squirming pink tip of worm projected from the front of its mouth!

The speed of the prey was not too important. Our horned toads also ate snails. Anything that moved along steadily and was not too formidable went the way of Agricultural Ants. A woolly bear caterpillar went unmolested (apparently too large) until we "shaved" it. These lizards commonly stand beside an ant trail and pick up each insect as it runs along in either direction. Yet if a few of the same ants find a horned toad while foraging, they investigate its back and take exploratory nips at the skin. The lizard closes eyes and nostrils, remaining perfectly still for a while. But there are limits to its tolerance, for the horned toad may suddenly scamper off, writhing as though in agony, brushing away one ant after another in its progress through the fallen leaves and litter. If ants still

cling, the lizard burrows into the soil and scrapes its body clean. It is clear, then, that only the inside of the horned toad's digestive tract is sufficiently sturdy to stand the bites and stings of insects. The seemingly tough and scaly exterior is too sensitive!

The relationship between horned toads and ants is obvious to everyone in the Southwest. In Arizona we learned that the Navajo Indians recognize as minor deities both the Horned Toad *yei* and the Red Ant *yei*. Stylized drawings of these animals form part of the Navajos' traditional sand paintings. On the floors of the juniper-walled hogans, the medicine men illustrate in bright dusts the *yeis* they pray to for health, rain, and fat sheep. The horned toad is a friendly member of the Indians' desert brotherhood.

Our detective duties proceeded through Utah, Wyoming, Montana, into southwestern Canada, and then down the Pacific coast. We became familiar with additional kinds of horned toads and at the same time kept our living collection for comparison and continual study. One of the adults from northern Arizona shed its skin and changed abruptly from a dull, spotted grayish-brown to a gorgeous creature with golden-yellow and glossy purple-black markings on its back. We must admit to helping in the skin-casting procedure. No one who enjoys peeling sunburn could sit by idly while a lizard was scraping off huge flakes of cloudy "cellophane" embossed in an exact replica of the body scales!

As we reached Salt Lake City, the weather turned still warmer, and we decided that the toads might not be getting enough water in their food. We should give them a bath. In the wash basin they objected frantically to any contact with the liquid, and one of us was so unkind as to suggest that all of them must be young males. But we held them submerged except for nostrils and soon noticed that enough water had seeped between their clenched jaws to give them a taste of the unfamiliar stuff. They were moving their lips and tongues just as if they had finished a meal.

We dunked them some more, and several toads proceeded to drink the warm water. Their throat movements were gratifying to see, and after the strange episode was over, these individuals were plainly heavier from the water inside them. We repeated this performance week after week. The lizards all drink now but not unless we hold their heads under. None take our offer willingly.

We are still puzzled to know whether the bath was responsible for the next bit of excitement. As we left Salt Lake City, roadside stands were full of beautiful apricots at astonishingly low prices. We bought some and were putting them away in the coolest part of the car when one of us said, "How are the horned toads getting along?" In the excitement of the discovery, the bag of fruit was spilled all over the floor. The lizards' carton contained eggs, eggs, and more eggs! Twenty-three of them. Which horned toad was responsible? Would there be any more? How should we keep them? Were they fertile? Might they hatch? When? To which the driver, thinking of the distance still to be covered on the trip, added, "Where?"

The parent was soon recognized by her distended body opening. She was the Texas horned toad that had been identified as the only certain male in the collection! The eggs were about  $\frac{3}{8}$  of an inch long and  $\frac{3}{8}$  of an inch in diameter. Each had a soft, leathery, pebbled shell, pale cream in color, which indented easily as though the egg were not quite full. The egg we opened contained an embryo about as far along as a hen's egg that has been incubated for three days. We put the rest aside and hoped they would hatch along the way.

As the summer progressed and the desert became hotter, we saw fewer horned toads at midday. Their activity seemed restricted more and more to the cooler hours of the morning or just before sunset. While our own preference was for the same time of day, it was hard to understand such behavior in creatures that obviously thrive best in the hottest parts of our con-



▲ IN THE PRESENCE of larger animals, the horned toad usually remains perfectly motionless. The kitten sniffed at the lizard and walked away, then returned and lay down to watch. The horned toad can scamper over the ground like a mouse, but it was poor game for the kitten

inent. Earlier in the season we had seen them at high noon, basking on warm rocks. Now, as sand temperatures rose to 110 degrees Fahrenheit and over, they stayed under cover except for the times of slanting sunlight. True, they would scamper forth for a few minutes into the full heat of day to approach an insect, but back to some shade they would scurry. A short exposure to 110 degrees F. or over is fatal to them. Odd, then, that they should inhabit only a region where such heat is common, even to the bottom of Death Valley and other hot spots where summer records show a shaded thermometer spending hours at 120 degrees F., day after day.

One day we cornered a horned toad beside a big rock and a very photogenic cactus in full, rich, red bloom. Here was a color picture for sure. But before we could get the cameras into position, the lizard had shown us how to escape both enemies and heat. With its head

as a shovel, it burrowed down into the coarse soil. First it made something like a trench; then, using the spiny fringe along the sides of its body, as well as all four legs, it sank itself under the sand until only the top of its head remained in sight. At this level the soil usually provides enough insulation for the lizard to stay cool and live, though even here the heat may penetrate, causing the creature to pop out of the sand and seek shade.

The answer to the riddle of the horned toad's distribution in relation to temperature seems to lie in the narrow range of temperatures at which its many body processes operate most efficiently—95 to 100 degrees F. A mere 80 or 85 degrees, which causes easterners to mop their brows and turn on the fan, hardly warms a horned toad enough to make it interested in food. Its digestive tract is still too sluggish to function well. Horned toads live in the deserts and plains

from British Columbia's Okanagan Valley to the Isthmus of Tehuantepec, and from Kansas to the Pacific coast, where they can count on summer temperatures that allow them to thrive. (They have also been introduced into Florida and other southern states.) The temperature at which full activity is possible is dangerously close to fatal heat; yet the toads require it. Their survival depends upon *warmth* from the sun rather than *light*. An electric hot plate turned on low just below a cage containing a horned toad, or a vent of live steam in the animal room, seems to be equally effective in keeping these interesting lizards alive and in good health.

At the foot of the Athabasca Glacier between Banff and Jasper, Alberta, and in the high campground at Crater Lake in southern Oregon, we felt downright sorry for our captive lizards. But the horned toad can stand cold far better than heat.

Under normal circumstances, it merely creeps into some sheltered spot for the night or during brief cold snaps. But when we began to shiver in our heaviest clothes, we did not forget our living collection. We took them into the tent with us at night, placed them between our sleeping bags, and covered them with a warm sweater. They quieted down and went to sleep, while dew stiffened to ice in the green canvas walls and roof. But the next day in the hot sun, they perked up and ate hungrily long before steaming coffee had induced us to shed our outer garments. Each year these lizards bury themselves for a winter hibernation; but even in summer at the elevations where many of them live, cold nights are no novelty to them.

Many bits of information accumulated as we observed the horned toads under natural conditions. Their protective coloration continued to intrigue us. Individuals of one widely distributed species would be pale and lightly marked on sandy or gravelly soil, while other members of the same

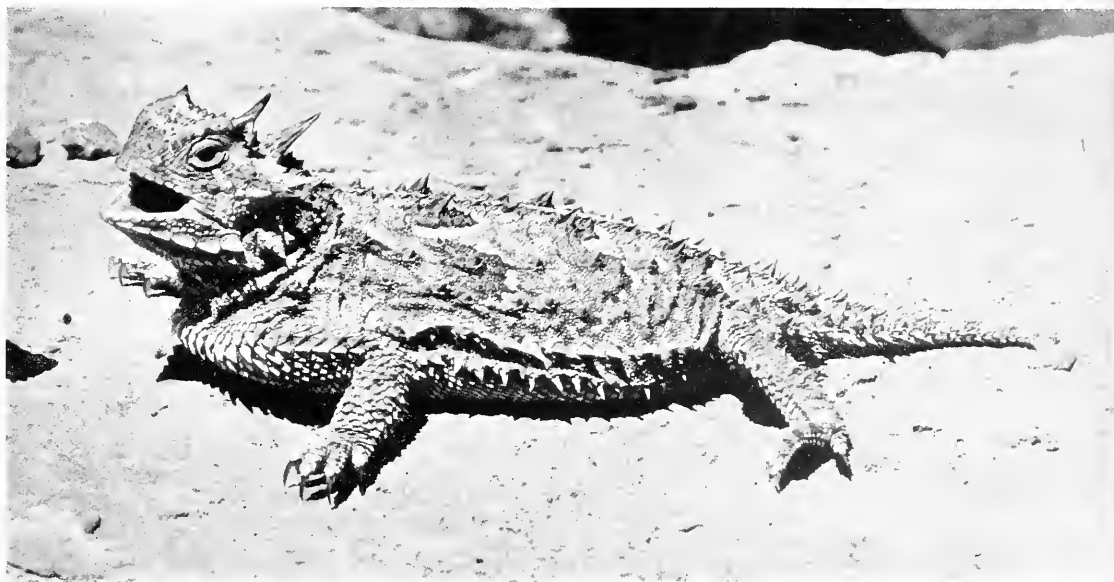
kind among the litter of piñon or ponderosa pine would match the darker earth below. Their backs bore few tan or cream areas. Greenish yellow, rich browns like those in a freshly fallen pine cone, and various glossy grays or black were the colors most frequently encountered. And specimens from regions with lava outcroppings were different again. Even the color of the horns varied. In some they were brown, in others rusty red, black, or yellow. Each seemed to blend perfectly with the land on which it lived.

Camouflage as complete as this seems unnecessary for horned toads, for few animals show any interest in them. Except for a strip of the United States along the Mexican border where the road runner bird is common, the toad has no important enemies. Cats sniff at a horned toad and walk away disdainfully. Mature dogs do the same. So far, we have been able to get only a puppy to paw at a horned toad, and then the gnawing was less violent than would be expected on an old shoe. However, the reptile

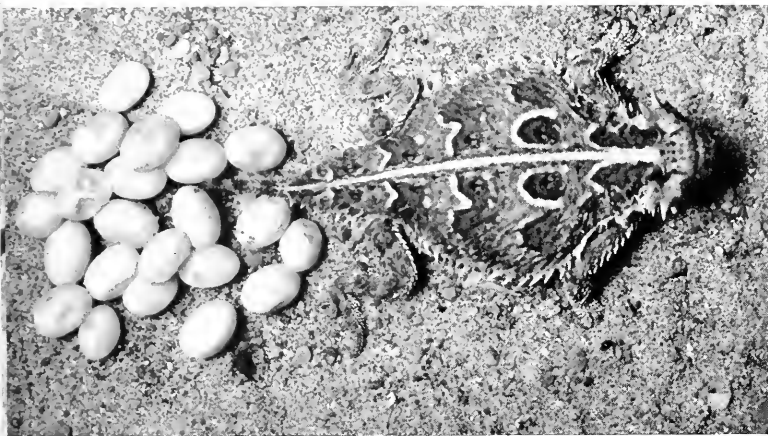
awoke from its feigned sleep and rushed away. The pup let it go, and we returned the lizard to its box.

There was a reason behind these experiments. We wanted desperately to see a horned toad exhibit its most weird protective measure. Under various kinds of provocation—from rubbing the top of the head to rougher investigation by a pup—horned toads have been observed to shoot a jet of blood from one or, on rare occasions, both eyes. Why this astonishing performance should terrify a potential enemy we cannot imagine, but the animal frightens its foes by sending the red droplets as far as six feet in an almost straight line.

This "hydraulic" defense system depends upon a mechanism common to many hard-headed reptiles. All the blood from their heads drains back into the general circulation through a highly muscular part of the jugular vein. Contraction of these muscles virtually stops the return of blood, and so the full pressure of the beating heart is transferred to the head. This causes a great swelling of the blood vessels



▲ WHEN THE SUN BEATS DOWN, the Texas horned toad may pant a while with mouth open before scurrying to a shadow or burrowing into the soil to escape the intolerable heat



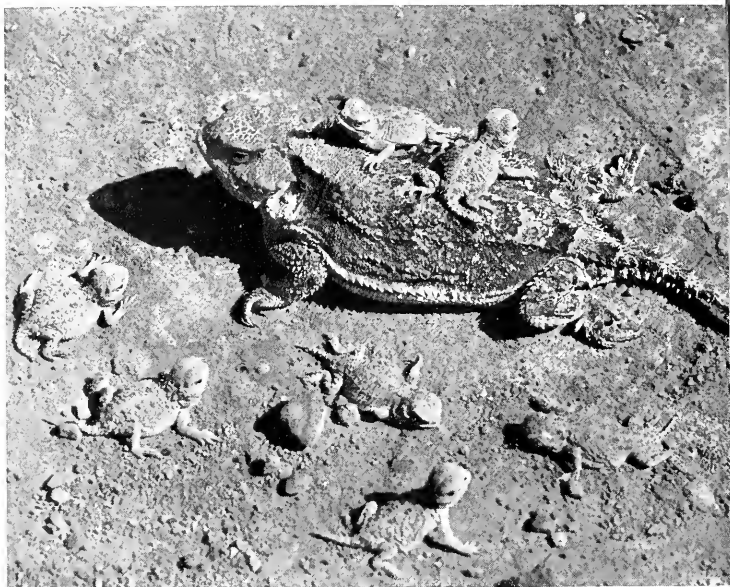
◀ THE TEXAS HORNED TOAD, like a few other kinds in the Southwest, lays eggs with flexible, cream-colored shells. It buries the eggs and leaves them to hatch in the warm soil. Often the mother weighs less after her labors than the total weight of the eggs just laid!

▼ THE ARIZONA HORNED TOAD gives birth to active young, a dozen or two at a time, at about six-minute intervals. The young ones may climb on their parent if she chances to remain near them, but she shows no concern for them. Each feeds itself, making quick dashes to the side to capture tiny ants

there, so that the eyes, lips, and areas around the external ears bulge into new prominence. Ordinarily the "swell mechanism" operates only when the lizard is molting, and it serves to lift the old scaly skin free from the inflexible areas of skull between eyes and mouth. You will see it in action if you affix a small flake of court plaster or scotch tape to one of these lizard's eyelids. But when frightened, the blood may also spurt from the horned toad's eye. The jet emerges from either the third eyelid or from the corner of the conjunctiva near by. No other animal's eyes are known to become as "bloodshot" as this.

The significance of this strange ability is still far from clear. One observer has suggested that the reptile performs only when it is about to shed its skin, or has just done so and is in full brilliance. Our experiences do not bear this out. Surely our "helping" the lizard with the molting process ought to have irritated it sufficiently! Some day we hope to be lucky enough to see a horned toad in full action.

We were driving eastward through Nevada when we discovered that one of our northern Arizona lizards had become more pugnacious than usual. We segregated it in a new carton and decided to watch for developments. Unfortunately, other tasks prevented us from inspecting this lizard until the following day. Then we got a shock.



For in the box there were *nine* lizards—the familiar but still pugnacious parent and *eight* babies! The young were very active, frolicking around and over their mother and occasionally getting stepped on as she moved about slowly, paying no attention to them whatever. Only when a youngster climbed up on her head and rested a foot on her eyelid did she react. Then she reached forward with a hind foot, calmly kicked the toadlet into a far corner of the box, and continued to scratch the place where

it had been. Her babies made her itchy, nothing more! Mother love was as absent as in Don Marquis' famous cat, Mehitabel.

But the babies were the most ambitious, awkward, energetic, black-eyed little lumps of pinkish brown that one could imagine. Their rubbery bodies seemed too delicate to stand such rough treatment. Time after time they fell over on their backs and lay that way for minutes. They recognized tiny ants that we dropped in for them and rushed after them, frequently making a



▲ A NEWBORN HORNED TOAD of the Arizona kind has difficulty straddling a silver dollar and weighs about 1/27 of an ounce

catch. But anything larger was beyond their instinctive ken, and they scampered away from all manner of little bugs. Like the adults, the toadlets spent many hours of the day and most of the night sprawled out with eyes shut tightly in deep sleep.

This was the end of July. The eggs had been laid by the other kind nearly a month earlier. And one of us had watched the mating of adults one May in Texas. The male takes a cave-man grip on his mate, not holding her by the hair, of course, but clamping his jaws on one of her larger horns! These details seemed to lay out a time schedule for us that encompassed the more private features of the horned toad's life. True, we had not witnessed a birth, nor had we seen the Texas toad excavate a nest six or eight inches deep, pack it with eggs, and conceal them by filling the hole again. But we proceeded eastward with our enlarged family, believing that our education was growing by leaps and bounds.

In New England we were soon unpacking our belongings, while the horned toads were active in dry

aquaria on a sunny window sill. They were busy, too, reducing the number of grasshoppers and flies we gathered for them. From time to time, one of us would sit down beside the caged lizards and watch them through the glass. The floors of the aquaria were littered with vegetable debris. Suddenly we recognized that something new had been added. There were one, two, three, four, five, very dead looking toadlets, each in an oblong glob of clear jelly to which particles of leaves and frass adhered. With a long pair of forceps, we reached into the aquarium and removed the babies to a glass finger bowl. We were bitterly disappointed that they had arrived when neither of us was watching and that all were dead. Then one wriggled. Perhaps they would live after all!

So intent were we on observing the babies in the finger bowl that we completely overlooked the possibility of more arriving in the main horned-toadery. When next we became aware of the parent or parents, two more babies were lying on the bottom. Which was the mother? Now all eyes were on the

big aquarium, and we finally saw an eighth youngster drop. Carefully we put the Arizona female into a separate dish, where we could keep better notes on her behavior. While our backs had been turned to seek the mother, the original five babies burst from their transparent sacs. They were now bright-eyed and very active, scampering around in the finger bowl. We had a two-ringed circus on our hands, and each show was a distraction from the other!

The interval between births averaged slightly over six minutes. During most of this time the mother remained entirely quiet, but when each "labor" period approached, she would shrug her shoulders and curl her spiny black tail upward. Soon the youngster would appear, enclosed in a clear, colorless fluid, in a delicate transparent membrane. After it was free, the parent would take a few steps forward. Her exertions each time totaled less than a minute, from onset of visible movements to complete separation of the youngster.

With so many toads and toadlets on our hands, we could do no better than keep account of them by number. Offspring TEN was born at 11:53 A.M. in a very full sac of liquid. Its tail was curled up against its belly, its legs folded neatly at the sides. But otherwise its back was straight—quite unlike the usual compact embryo. The whole seemed perfectly cylindrical, in contrast to the broad, flat adult. Eyes and nostrils were closed. The undersurfaces were grayish white, and the back markings showed only faintly in the pinkish-yellow ground color. A short umbilical cord clung to the abdomen.

Fourteen minutes after birth, this youngster had burst its sac at the head end and extended itself enough to get its nostrils into air. Irregular breathing movements began and continued while the clear fluid drained from the sac. Soon the lizardlet wriggled, and gradually the collapsing membrane shifted farther and farther back toward the now extended tail. At nineteen minutes of age, the sac came free from hind legs and tail, and as though

With so many horned toads on our hands after collecting only a few adults, we rather look down on Ellis Parker Butler and his "Pigs Is Pigs" story. When it comes to compound interest, no hay-eating guinea pig can compare with the horned toads we brought home.

## NATURAL HISTORY, FEBRUARY, 1949



500-fathom line marked approximately the area of three-inch leptocephali. He also found that they were still about that distance from land, when, late in summer, they began to undergo the change that Grassi and Calandruccio had observed and described in such detail. By the following spring, they had become elvers and had also reached the mouths of the European rivers.

Unfortunately, the "Thor" was a small ship. It could not cruise for long beyond the 500-fathom line. Doctor Schmidt returned home, and then he received a report from the S.S. "Michael Sars," a Norwegian survey ship, that a much smaller leptocephalus had been caught far out in the Atlantic. Not having a ship comparable to the S.S. "Michael Sars," Doctor Schmidt did the next best thing. He contacted all the captains of Danish vessels sailing the Atlantic and asked for assistance in the search. He "held classes" for the old salts, telling them what to look for. He promised to furnish special nets. And he begged them, for the sake of science and the Danish fisheries, to make stops in mid-ocean to see what they could catch.

Twenty-three captains promised to co-operate. Among them, they made 550 stops to and from America to fish for eel larvae. Among them, they caught 120, a very small figure

indeed but a significant result when the successful stops were located on a chart. It showed that the eel larvae seemed to have definite travel routes, that they did not just swarm all over the Atlantic.

By 1913, Doctor Schmidt had a good idea where and when to look, and he sailed on the small schooner "Margarete" on an oceanographic expedition devoted almost exclusively to one fish. The number of leptocephali increased and their individual size decreased toward the southwest. In that direction, undoubtedly, lay the true spawning ground. The "Margarete" ran aground in the West Indies after only a half year of service; but Doctor Schmidt knew by then that the spawning grounds were in, or rather under, the Sargasso Sea. Further research was interrupted by World War I, even though Doctor Schmidt's country was neutral.

In 1920, he returned to work, on the four-masted, engine-powered schooner "Dana." By then he and everybody interested knew that Grassi and Calandruccio had made one mistake. The leptocephali they had caught off Messina had not hatched in the Mediterranean but in the Atlantic, like all other European eels. And like all American eels. Meanwhile, American ichthyologists had shown that the American eel also left the rivers for the

Atlantic Ocean, that it also started out as a larval form which changed into an elver. In the larval stage the American eel looks like the European eel, and both are hard to see. There was just one way to tell them apart, a way which required endless, tedious, and difficult counting aboard the "Dana."

Leptocephalus is made up of many segments. These number between 106 and 109 for *Anguilla chrysops*, the American form, and between 113 and 117 for the European form. Occasionally the American variety had a few less, as little as 104, and the European a few more, as many as 119. They met at 111, and five specimens with that critical number of segments were caught. Nobody can say whether these five, if left alone, would have ended up in the Rhine or in the Hudson. The other 7000 specimens clearly belonged to one group or the other. Imagine counting the segments in 7000 specimens, most of them only an inch long and all, of course, transparent!

When Doctor Schmidt had neatly entered all his facts on large charts, one could see what happened. When the European eels left their rivers in the autumn (Schmidt, of course, was mostly interested in the European variety, for good commercial reasons), they seemed to travel with steady, high speed, arriving in the Sargasso Sea around Christmas and the New Year. Where they laid their eggs was not quite certain, but it was *not* among the drifting weed at the surface. It did not seem to be at the bottom of the sea either, since the ocean is quite deep under the Sargasso Sea. In any event, the smallest larvae, only about 7 millimeters, or  $\frac{1}{4}$  inch long, were caught at about 1000 feet. During the first summer they grow to a full inch, or 25 millimeters; during the second summer they double that length; and during the third they reach 75 millimeters. Then, after the change, they swim upstream. Thus their travels consume 3 years, at the rate of about 1000 miles a year, and they evidently "ride" the Gulf Stream for much of their journey.

The American eels, which seem

**Winners of the River Cryptomaze** in the December issue of NATURAL HISTORY: The three contestants submitting the highest number of rivers listed in the Gazetteer of Webster's New International Dictionary (1948), in accordance with the rules of the contest, are: HAROLD EATON, Jackson Heights, N. Y.—54 rivers; W. D. STANTON, Cohocton, N. Y.—54 rivers; CAROL L. KRUEGER, Chevy Chase, Md.—53 rivers. Each of these winners has received a copy of *The Earth's Graudest Rivers*, by Ferdinand C. Lane, published by Doubleday & Company.

Rivers both above and below the line at the bottom of the page in the Gazetteer were counted, but variant spellings of the same name were not. Neither were more than one river of the same name. (It was not implied in the rules that, in spelling a name, the contestant could jump up and down on the same square to form a double letter. Where this occurred, the contestant was not disqualified, but he was not given credit for the river.)

Several contestants, by using sources other than Webster, produced lists considerably longer than the winners. They were not disqualified for doing this but were graded only on the rivers that satisfied the requirements of the rules, and on these they did not excel the winners cited above. Honorable mention, however, should be given to: William H. Loery, Staten Island, N. Y.; M. Douglas McLroy, Ithaca, N. Y.; and D. H. Fry, South Pasadena, Calif. Other contestants too numerous to mention also made creditable scores.

to hatch in separate camps under the Sargasso Sea, travel at the same rate, but since they are only about 1000 miles from home, their growth is adjusted to the shorter time at their disposal. They are as large and as advanced when they reach their rivers as are the European eels.

The discoveries of Grassi and Calandruccio enabled both the Italian and the French fishery commissions to do what had once been tried with cut-up horsehairs and grass sods: to restock water depleted of eels. The French, especially, kept careful record of their

work. They reported that each ton of elvers seeded into swamps and small waters off the river Aisne resulted in 2500 tons of food in 5 years.

Pliny may have been right when he gave "eight years" as the average time that eels need to reach maturity; the females seem to require from eight to twelve years and the males from five to eight. Then they go on a complete fast; aquarium specimens went foodless for six months until they died, which is reason for believing that the eel spawns only once and dies soon afterward. But some individuals do

not mature sexually; these have been found to live more than 20 years and to reach a length of 6 to 8 feet and a weight of 30 pounds.

It may also be added that the Conger Eel, which stays in salt water, goes through the same transformation as the common eel, as does a variety of other eels and fishes. Its larva is *Leptocephalus morrisii*.

And finally, neither the water of the Danube nor the surface water of the Black Sea is "inimical" to eels. Perhaps the eels just can't make that long a trip before they are ready to be "river eels."

## THE MYTH OF THE BALANCED AQUARIUM

Continued from page 77

placing fish in sealed vessels of water containing various concentrations of carbon dioxide. After the fish have been asphyxiated, appreciable amounts of oxygen will still be found in the water, and the greater the initial concentration of carbon dioxide, the greater will be the amount of oxygen remaining after the fish's death.

From this experiment, it is quite apparent that carbon dioxide actually prevents the fish from utilizing all the oxygen present. This is what its effect in an aquarium must be. In other words, fish can be starved for oxygen with plenty of it all around them, because they cannot take it into their bodies in the presence of relatively excessive amounts

of carbon dioxide in the water.

Fish are suffocated in an aquarium by an excess of carbon dioxide, not a lack of oxygen, except under extraordinary conditions when a real oxygen deficiency may exist.

The reason the aquarist gets along so well, even while working under the wrong premise, is that he is doing the right thing—for the wrong reason. For example, when he aerates his tank's water or circulates it, he is not introducing more oxygen, as he usually believes, but facilitating the escape of carbon dioxide.

"A vessel of water containing plants and animals must be looked upon as a little world," wrote Edwin Lankester in 1856. We can now

just as categorically state that it must *not* be so considered. Although the physiology of plants and animals in an aquarium is identical with the physiology of those in the world at large, the part they play in the ecology, or bionomics, of their tank is quite different from that taken by the sum total of all life in the earth's grand economy. In this sense, an aquarium is not at all a microcosm but merely a part of a macrocosm—part of a larger world from which it cannot be either physically or ideally separated. No balance could be expected to exist in such an open system. Looked at logically, the whole idea of a balanced aquarium seems baseless. But then, most myths never made a pretense of being logical.

## BOOKS

Continued from page 55

outlet in natural science, education, mining engineering, exploration, collecting on a hitherto unprecedented scale, business management, and showmanship, but even up to the time of his death in 1906, he still yearned for other worlds to conquer.

As a scientist, his chief interest lay in fossils, though under the guiding spirit of Louis Agassiz his conceptions were greatly broadened and injected with a devotion to truth which even P. T.

## SEA AND LAND SHELLS

If you are a buyer of this class of invertebrates send for my Conchological Chatter which appears monthly listing choice Mollusca from every part of the world. Collections for sale of any size up to 5000 species. Also books on Mollusca.

WALTER F. WEBB

2515 Second Ave. North, St. Petersburg 6, Fla.

Barnum, the great showman from whom he learned many tricks, could not undermine. Nevertheless, despite his successes in founding museums and supplying them with exhibits (typically a plaster Megatherium skeleton surrounded by meteorites and fossil casts), he could never live down the suspicion, born of the esoterism of his day, that he was cheapening natural science through commercialization.

The book also throws some interesting high lights on the religious controversies arising from the advent of Lamarckism and Darwinism, which were particularly acute in the vicinity of Rochester, the birthplace of Mormonism and the Shaker communities. Thus Henry Ward, in addition to the economic problems of securing financial support for his enterprises, had first to awaken a scientific interest in many prejudiced minds.

In evaluating the character of Henry

Ward, as portrayed by Roswell Ward, certain allowance must be made for a grandson's partiality. Yet, there is no evidence of "build up," but merely a straightforward narrative that speaks for itself. The presentation is simple, entertaining, and humorous in a quiet way, with all the documentary evidence relegated to the last pages. But, behind this simple result, lay the monumental task of collecting and collating the vast and scattered Americana that marked his grandfather's career. For this labor of love and devotion, Roswell Ward is to be highly commended.

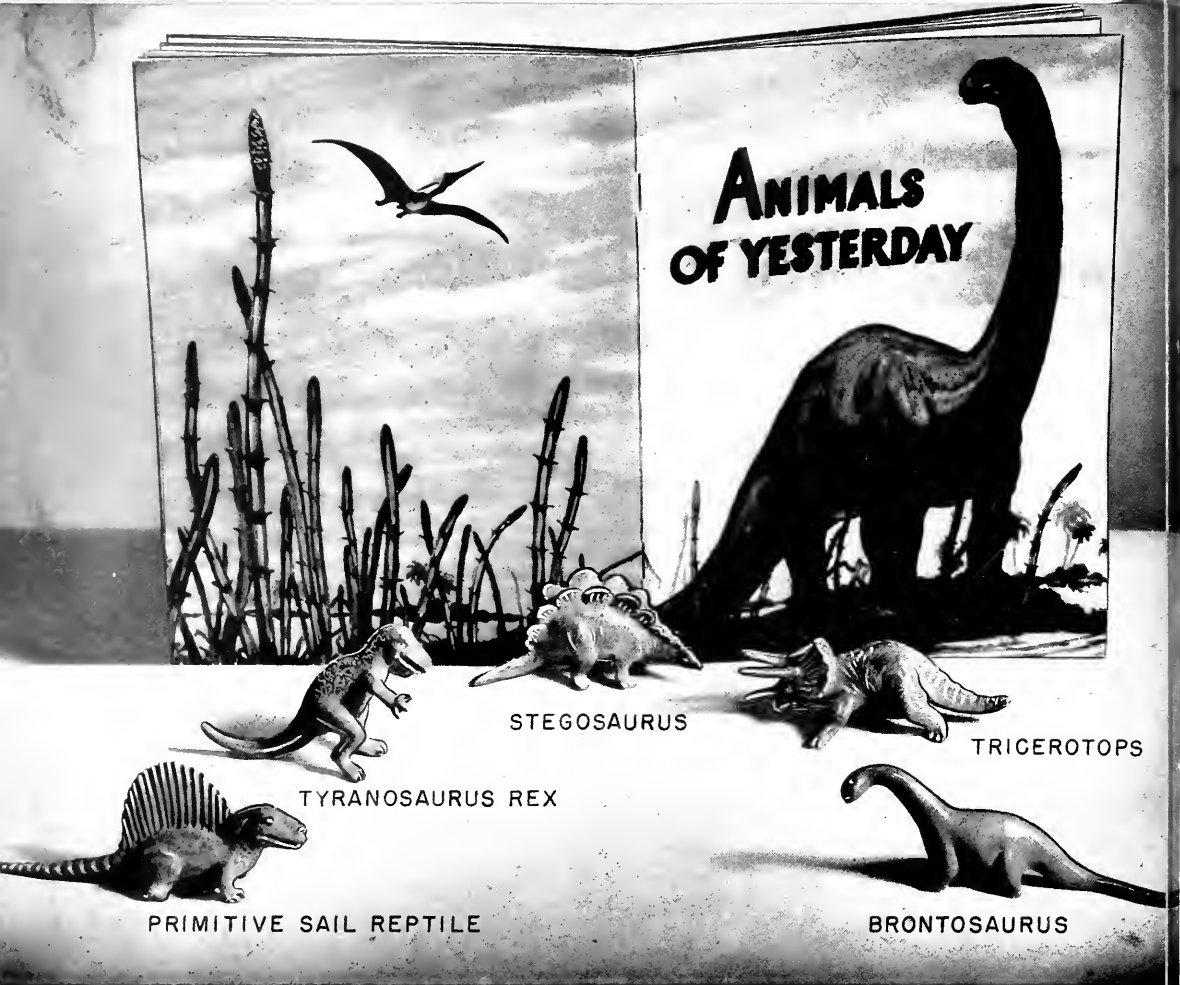
It should be of special interest to all affiliated with the American Museum and the New York Zoological Society to learn that Frederic A. Lucas, William T. Hornaday, and Carl Akley owe their rise to fame very largely to the influence of Henry Ward and his Natural Science Establishment. GEORGE H. CHILDS.



*March* **NATURAL HISTORY** 1949

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# LETTERS

## **Mass Invasion by Red-billed Queleas**

Sims:

Every year during December and January the fields of kaffir corn (millet) in the western Transvaal are devastated by enormous swarms of red-billed queleas. As much as the farmer might loathe this gregarious finch, it offers to the student of natural history a fascinating subject for the study of flock behavior.

To investigate press reports on enormous damage done by these birds, I went with two other members of the Witwatersrand Bird Club to Bloemhof, on the Vaal River, to inspect the breeding colonies of the queleas.

Although small flocks were constantly encountered, we were told that the main colony had broken up three weeks before. What we found was a ghost city of birds. An area covering roughly 800 yards by 1 mile, thickly infested with thornbush and medium-size thorn trees (mainly acacia karroo and *Zyziphus mucronata*), looked from afar like an orchard heavily laden with oversized fruit. These were the nests of the queleas, and they averaged 50 per tree. One hundred adult birds per tree gave us a conservative estimate of two to five million birds for the colony.

Local inhabitants who had seen the colony at the peak of its activity said that the noise had been unbearable and that when the birds rose they covered the sun like a thundercloud. Now the place was utterly deserted and dead. With the



queleas, all other life seemed to have departed. In the distance a laughing dove was cooing, and a few glossy starlings flew overhead. That was all.

Many of the nests, falling slowly to pieces, still contained eggs—sometimes whole clutches and not infrequently a dead fledgling, mummified, left to starve by the parents. What is this spirit of the swarm which calls the birds away and

breaks their family ties? Where do the millions go? Are they lost in the wide, unexplored wastes of the Kalahari, emerging again next season to breed where the kaffir corn ripens?

During one month they do great damage, but what are they eating during the rest of the year? Some irate farmers are talking about flame throwers and poison gas, but can we foresee what would hap-





▲ **DARK WATERS**, a photo-study to kindle thoughts of warmer, sunnier days. By Fritz W. Neugass

pen if those millions of queleas were exterminated? How many tons of noxious weed seeds, how many millions of grubs, must find their way down their beaks!

Have you any suggestions how to minimize the damage without interfering with the laws of nature too much?

Dr. W. GILGES, *Chairman*,

*Witwatersrand Bird Club*.

Johannesburg, South Africa

The following comments are offered by Dr. James P. Chapin, eminent authority on Africa in the American Museum's Bird Department:

The fabulous swarms of red-billed queleas in many of the drier regions of Africa have long been famous. One ob-

server in the Blue Nile region wrote of "hundreds of millions"; another in south-west Africa reported migrating flocks that took three days to pass his farm and gathered meanwhile in vast numbers at a drinking trough for cattle.

Where these superabundant birds nested was long a mystery, and then about 30 years ago their great colonies in remote areas of the bush began to be discovered. Nests are often abandoned even before the eggs have been laid, but successful breeding must be frequent enough.

These are by no means the only members of the weaverbird family to raid ripening fields of kaffir corn, rice, and other cereals. Bishop birds and whydahs,

in many regions, do the same. All across the Sudanese belt every year, the natives are obliged to mount guard as the grain ripens. Women and children patrol the fields to drive off the birds, the boys shooting little reeds from their bows; and other watchers build platforms in trees.

In rainier equatorial countries, prominent trees in the villages are occupied by considerable colonies of yellow and black weavers, which often fly down into gardens to peck at ripening ears of maize. The people even the score by gathering numbers of well-grown young from the nests and using them as food.

It will be well to study the age-old experience of natives before applying too drastic methods of control. During part of the year most finches destroy numbers of insects, and the seeds they devour are largely of no economic value. The right to protect crops cannot be questioned, even if a small proportion of the birds may lose their lives. Here in the United States, ducks, crows, and blackbirds are often found to be detrimental in grain fields; starlings and robins in fruit orchards. Yet careful research has shown that none of these birds should be decimated.

In Africa inanimate scarecrows are apt to be useless. People moving about the fields during the few weeks just before harvest time are far better. They may well wave flags on poles and make all the noise possible. Africans are splendid singers and drummers. Some mechanical source of high-pitched noise might supplement their efforts; and transcriptions of shrill African music delivered through loudspeakers would seem ideal. But that, of course, would cost far too much.

#### **Turtles Basking on Ice**

Sirs:

I am not out to "stump the experts"; neither am I an expert. But the *Union Sun and Journal* of Lockport, N. Y., recently published an item telling how, one day last month, several turtles were seen basking on the ice of Hopkins Creek. By the end of the day, 12 had been caught, among them a 20-pounder. Such an event is said by local residents to be unheard of.

I have come to appreciate your letters of explanation in *NATURAL HISTORY* and would like to know what you think of this—not only for my own benefit but for others around Lockport, including 13-year-old Richard Blackley, who wrote

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# NATURAL HISTORY

*The Magazine of the American Museum of Natural History*

F. TRUBEE DAVISON, President

WAYNE M. FAUNCE, Vice-Director  
In charge of Publications

ALBERT E. PARR, Director

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## THE COVER THIS MONTH

The American Turk's Cap Lily (*Lilium superbum*) is found over a wide range from Minnesota east to the Atlantic coast and from southern Canada to North Carolina.

The blooms are large, pendant, and recurved, varying in color from orange to orange-red, deeper toward the tip of the petals, and spotted with brown or crimson on the throat.

The height of the plant varies from five feet in the sun to nine or ten feet in shady places. Not particular as to soil, it thrives equally well under acid or alkaline conditions. It is contented on any ground that will grow good potatoes and will succeed in soil too soggy for them. Indeed, this color photograph by Arthur B. Close was taken in a marshy location.

The Turk's Cap Lily adapts itself to a variety of situations. It is decorative in a mixed border or may be naturalized in moist woodlands or meadows. The flowering season is July or early August, depending on latitude. Basal rot is unknown, but like most lilies, it is subject to the virus "lily mosaic," which mottles the leaves and, in severe cases, distorts the stem buds and flowers as well.

C. L. H.

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EDITOR: Edward M. Wever, Jr.  
Elizabeth Downes, Editorial Assistant.  
Atherlie E. Karp, Editorial Assistant.

ART AND PRODUCTION: Robert E. Williamson.  
Jean Bruck, Assistant in Art and Production.

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to me about it. Inquiries reveal nothing unusual in the conditions on that day except that the temperature above the ice was about 70°F.

ROY B. KELLEY.

New Hartford, N. Y.

The following information is offered by Bessie Matalas Hecht of the American Museum's Department of Reptiles and Amphibians:

I find at least four authenticated records of snapping turtles being observed during the winter months in mud near melting ice and in water beneath the ice. In none of these cases, however, was more than one individual found at a time, which makes this newspaper account interesting. That several should have been seen basking on the ice, and that twelve should have been caught, may be explained by the unseasonably warm air temperature of 70°F. Only one air temperature is recorded for the other occurrences, and that was 33° F. below the present record.

Cold-blooded animals such as turtles derive their body heat from external sources. When the temperature drops, turtles hibernate in places where they will be protected from extreme cold. On mild days, as the heat from the sun warms the earth, the turtles have their body temperatures raised, and they become active, leaving their hibernating places even though it may be in the middle of winter.

The snapping turtle sometimes hibernates singly but more often in large aggregations and in a variety of places—under logs, in muskrat burrows, or in one or two feet of mud at the bottom of a stream. Because one of these hibernating "dens" may yield quite a few turtles, commercial collectors hunt them more often in the winter months, probing for them through holes in the ice. Catches of as much as 500 to 1000 pounds have been reported in a single day.

### "Them that Has, Gets"

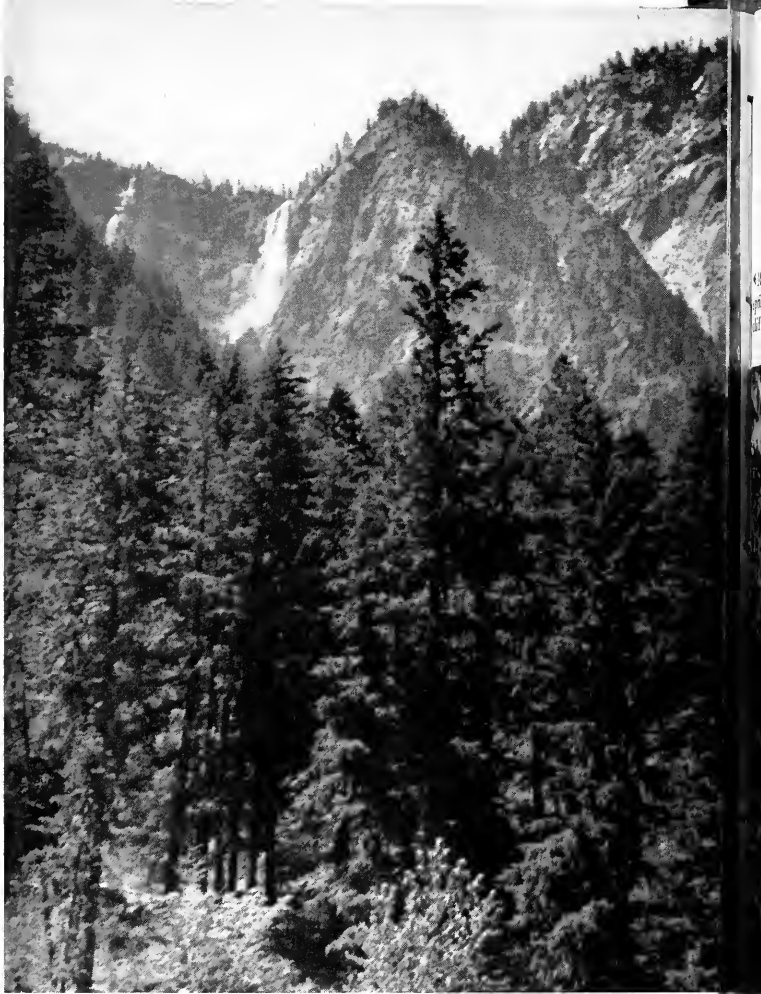
SIRS:

Congratulations on your new feature "The Cryptomaze." It seemed impossible that an already perfect magazine could be made still more perfect, and yet it would appear that that has been accomplished.

However, there is one little thing that has amused me greatly in January's word maze. The person who secures 23 wild mammals wins a copy of *Wild Animals of the World*. Well, I don't believe that anyone who succeeds in doing this needs a book like that! They either already own it or could easily compile a similar book! . . .

MRS. ARTHUR E. LAMB.  
Brooklyn, N. Y.

Mrs. Lamb may have something there.—ED.



### Too Small to Bother With

SIRS:

On a recent visit to Florida, I saw sharks, sting rays, giant morays, and other public enemies of the deep peacefully mingling with fishes that were smaller and less able to defend themselves, in the great aquariums at Marineland. Local attendants mentioned that adequate feeding prevents fish fights and that sharks and others attack only when hungry.

While lack of appetite might account for a shark's good behavior, it would hardly explain the little fish's lack of apprehension. It all surprised me very much. Surely a zoo could not mix such a variety of creatures. What is the explanation?

JOSEPH P. CROCKETT.  
Washington, D. C.

The following answer is offered by James W. Atz, Assistant Curator at the New York Aquarium:

Adequate feeding will, of course, reduce the aggressive behavior of pred-

tory fishes, and this probably partially accounts for the peaceful conditions at Marineland. There are, however, other factors. Predatory fishes do not necessarily prey upon all smaller fishes; in fact, they ignore those that are apparently too small to bother with. One of the tricks in keeping fishes of various species together is to have the difference in size so great that the larger ones will not concern themselves with the smaller ones. At the old New York Aquarium we were able to keep two species of killifishes with savage green morays.

It should be noted that the shark is not agile enough to catch many of the smaller fishes and that the sting ray feeds on invertebrates, such as crabs, worms, and shellfish, rather than on other fishes.

The fearlessness of the smaller fishes is easily explained. Fishes can adjust themselves very rapidly. They quickly "learn" that the large fishes in the tank will not try to eat them, and they soon lose any fear they may have had of them in the wild.

### ***Cascades in Spring***

SIRS:

Beautiful waterfalls along the sky line and spray-filled streams are to be seen in the Cascade Range in springtime when

the warm sunshine melts the winter's heavy snow. Such scenes as the ones shown here can be viewed at many places on the highway across Stevens Pass in the state of Washington. They rival many famous ones.

Making the trip in the spring, the na-

ture lover thrills to the sight of the "cup that runneth over." When he returns in midsummer, it is like driving a different highway, for not a single waterfall is seen along the mountain road.

MARGARET MEYER.

Seattle, Wash.

MELTING SNOWS, under a warm  
spring sun, find an outlet over a  
cliff

▼ A MOUNTAIN STREAM dashing itself to spray in a wild  
plunge to keep its age-old tryst with the ocean





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## LET'S GO TO COLOMBIA

--- by Ellen and Lyman Judson

Harper and Brothers, \$4.00  
352 pp., 52 photos, 19 maps

THE traveler, the armchair explorer, the North American resident of Colombia, yes, and the English speaking Colombian will find this a fascinating source of accurate information. Combining the best features of a Baedeker with crisp vignettes of legend, history, art, and humor, the sparkling pages one moment will have you traveling through back streets to seek out a tiny gold figure in an altar niche of an ancient church, and the next, with Drake, pillaging a fortified treasure city with 120 ships and 1300 men.

In bed slippers or boots you can wander the fabled Andes, even to the innermost fortress city, Bogotá, the "Athens of South America," where occurred the greatest coincidence in history when three invading bands of conquistadores, seeking Chibcha gold, converged from different directions at the top of the Andes after treks of discovery which even today overwhelm us with their immensity.

The traveler will find among the copious historical notes a bounty of necessary information in the form of tips as to the location of frozen foods, pre-Colombian goldwork and shrines, modern gown shops, salt mines, waterfalls, airports, ultramodern architecture, good hotels, bullfights, tropical agriculture stations, Indian tribes, and oil fields. Also included are tips on liberal and conservative newspapers, legal holidays (unfortunately not all are included), clothing, and equipment.

Packed into a "What's What" section is copious information on Colombian geography, climate, political subdivisions, population, government, language, religion, products, exports and imports, transportation to and within the nation, money, communications, etc.

Important facets of this work are the "Judsonmaps" of all large cities, as well as general maps and the 51 excellent photographs.

In short, the first of Harper and Brothers' "Judson Guides to Latin America" is a spanking good job. It makes one say: "Let's go to Colombia."

THOMAS E. GILLIARD.

## CITY OF THE BEES

----- by Frank S. Stuart

Whittlesey House, \$3.00  
243 pp.

ON the paper wrapper of this book the publisher makes the claim that in it "the marvels of a society older than man, and almost unknown to him, are revealed." If man in the sense of the general reader remains uninformed regarding the honeybee, it is certainly not the fault of the specialist. E. K. Phillips, for many years in charge of bee culture investigations in the United States Bureau of Entomology, has pointed out that hundreds, even thousands, of books have been written on bees and beekeeping and that "no other insect, and perhaps no other animal except man, has been so voluminously discussed." In view of the available accounts of established repute, one is inclined to look rather searchingly at any new claimant for admission to the order of merit and, where that claimant is found wanting, to be perhaps unduly harsh. This reviewer, at least, cannot help expressing his regret that the literature is encumbered through the addition of the present perfervid volume, which contains too much of a misleading character to be the preceptor of the uninformed.

The author describes the book as "an imaginative fantasy," yet he includes enough of the factual, even if embellished, to convince one that the work is not a contactless flight of fancy. The pages reek with anthropomorphism. An extreme case—but others as high-powered might be cited—is that of the "old soldier bee" who attracts the glances of the "nurse bees." We are told that the "soldier" is not to be blamed if it "cocks its whisker yet more fiercely, and rolls a languishing and magnificent black eye. Nursemaids and soldiers were ever thus." The reader need hardly be told that this imagery scarcely fits a creature that has an immobile compound eye, and that both the "soldiers" and the "nursemaids" are sterile females undifferentiated struc-

turally. Such an alleged flirtation would indeed be empty and anemic!

HERBERT F. SCHWARZ.

## NATURE'S UNDISCOVERED KINGDOM

----- by Walter J. C. Murray

George Allen and Unwin Ltd., London,  
The Macmillan Co., New York, \$2.00  
98 pp., 19 photos

EVERY age has its poets and philosophers who "discover" nature's kingdom. Some draw word pictures; others paint and sketch. The author of this small book of nature studies has augmented his pen with the camera. The reader will enjoy the pictures but will remember the author for his lyric prose and sensitivity rather than for his photographic skill.

This work is "an attempt to understand the world of wildlife from a new angle." This "new angle" of understanding is the intimate contact with and response to nature on the part of an observer who is not merely content with knowing "the life history of every bird, beast and insect."

After this warning, the author takes us with him to mountaintops, to lush meadows, to overgrown copses, to blue tarns, and moist bogs. We watch with him the growth of a pet kestrel and we listen to the sounds of nature—the wind through tree branches, the shrill cries of hawks, the brisk chattering of squirrels. We see great flocks of birds darken the sky, moths gathering about lights in the evening. We tramp the countryside of the British Isles looking, listening, touching, tasting, and smelling. In addition to being a keen observer, our guide is a philosopher and a sensitive interpreter of nature. Indeed, the cool and calculating among us might say that he is rather emotional. He indicates the appeal nature makes to him when he writes: "Have you ever embraced a great tree in sheer wonder and delight at its towering strength and felt its rugged bark upon your cheek? Have you brushed with your lips the velvet of a newly opened flower in joy of its blossoming? Have you talked with birds? Have you at sunrise knelt with the heather on the mountaintops in adoration? These are a few of the notes in the great score." This is a book for anyone

Continued on page 142

## NATURAL HISTORY BOOKS

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itself in a few years of capacity operation.

Results thus far have been discouraging. Only a small proportion of the land scheduled to be cleared has actually been combed with a plow, and only 7500 acres were planted last year. The estimated cost of the entire program has been revised upward 100 per cent, and the plan for 10 Kenya plantations will probably be dropped. Much of the equipment for the work was surplus war machinery which was found to be in a deplorable condition, and there have been few dollars to buy American tools for the job. The yield has been disappointing in many cases, even after the land was cleared and fertilizers applied. In one instance, on a different project, it was reported that thousands of acres of Masai land in Tanganyika were cleared for a wheat ranch. After some 2000 head or more of game had been shot, wheat was planted, but the yield was an infinitesimal half a bushel an acre. The game had been killed off, the land plowed and ruined, when the whole project had to be abandoned.

Nevertheless, the government is determined to go ahead with its ambitious schemes and will no doubt eventually make most of them successful. Partly because of the publicity given the peanut plan.

restless Empire war veterans and civil servants displaced from India and Burma have turned land-hungry eyes on East Africa in recent years, and there has been a rousing boom in real estate, farms now bringing triple their 1938 prices. Lack of equipment, fencing, and other needs have hampered pioneers. Some of them have had to wait years for the barest essentials, and money and equipment have been lacking even to provide the

the peanut farms alone, and that will mean stores, hotels, and subsidiary settlements.

The military is not the least prominent feature of the flood of European civilization welling into the once-dark continent. The transfer of the great British Middle Eastern military headquarters from the Egypt-Suez area to Nairobi, and continued exploitation of the immense uranium wealth of the Congo, with the consequent speedy



After E. E. Austen and Emil Hegh

▲ THE TSETSE FLY that is the most common carrier of human African sleeping sickness—*Glossina palpalis*

colonies with adequate roads.

But despite high prices, low productivity of much of the land, lack of materials, and the immense problems posed by the nature of Africa, the industrial age is coming to the sleepy eastern colonies, with all the roar and clatter of bulldozers and gang plows. On sketch maps of the vast territories, the proposed farms and ranches look no more important than fly specks on a wall, but their effect on wildlife will extend far beyond their own geographical limits. New railroads and ports, will be built, new roads laid out. Villages will be needed to house the 32,100 Africans and 730 Europeans who will be needed for

development of that once forbidding colony, would indicate that Africa is due for a swift modernization, even making no allowance for agricultural expansion. The hugely accelerated development of the continent brings the wildlife problem into sharp focus.

The Managing Director of the United Africa Company admitted that government hunters were shooting game in an effort to eliminate it from proposed plantation sites, but he explained airily: "Once the game knows it is an unhealthy area it will disperse." Food Minister John Strachey, in a somewhat labored reply to a question about the fate of the wild creatures in the



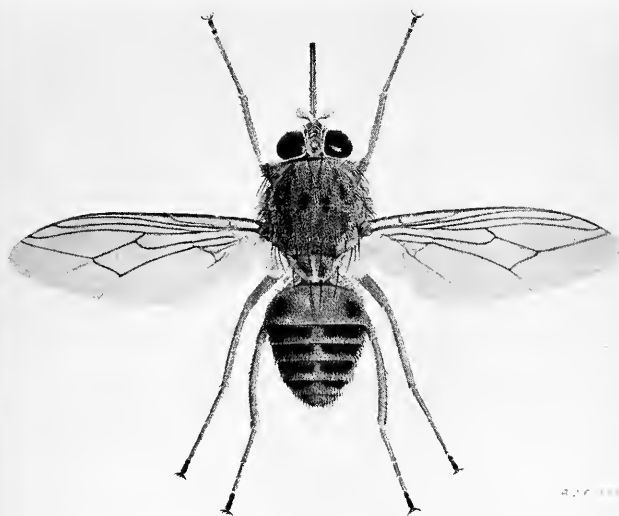
vicinity of the ranch sites, suggested:

"Let me have them for our meat ration."

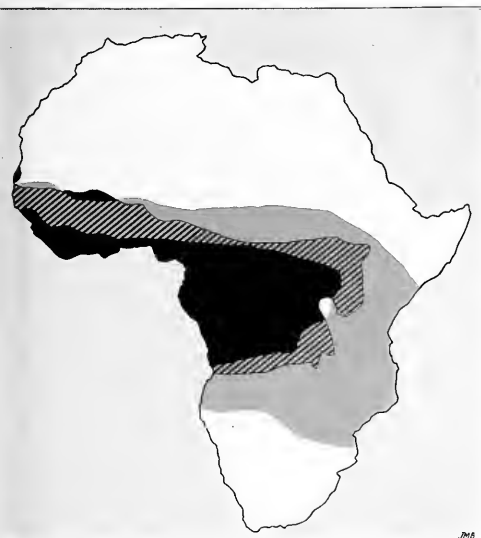
Whether or not it is good sense to trade the earth's most glorious animal life for peanuts, we should realize that civilization and physical development must and will come to Africa. Nothing can stop the advance, and the energies of those who would protect the game had better be directed toward seek-

ing some formula permitting continued existence of large and representative blocs of wildlife within a civilized community, rather than jousting at windmills in a futile attempt to stem an irresistible force.

The fly called tsetse comes in many guises. At least 21 species have been recognized, all called *Glossina* something-or-other. At least some species bring sleeping sickness to man, and some cause nagana in domestic livestock. The wild ani-



After E. E. Austen and Emil Hegh



▲ *GLOSSINA MORSITANS*, carrier of the cattle disease nagana and of human sleeping sickness in certain limited areas

◀ DISTRIBUTION of two of the most important tsetse flies—*Glossina palpalis* (black area) and *G. morsitans* (colored area). *G. morsitans* formerly extended somewhat farther to the southeast. The bars represent overlap

Drawn according to information from J. Bequaert, Curator, Museum of Comparative Zoology of Harvard University



AMNH photo

▲ EAST AFRICAN KLIPSPRINGER, a specialized rock antelope found wherever there are suitable rocky hills, from the Cape Peninsula to the southern border of the Sahara

imals of Africa have apparently acquired an immunity to nagana. Tsetse is probably indigenous to Africa alone.

The flies feed only on blood, and although some few types can live on cold-blooded creatures, such as reptiles, most depend on the warm-blooded mammals. Some species of *Glossina* concentrate on large game animals, and some on the smaller game, like wart hogs or bushbuck. The female fly hatches one larva at a time, leaving it to pupate in the earth. The fly merely acts as an agent, or insect taxicab for the disease, sucking up the pathogenic trypanosomes from an infected animal with the blood it drinks and passing them with its saliva into the blood of some other creature.

Dangerous though the flies are, they have two weaknesses through which they may be controlled. One weakness is their comparatively



AMNH photo

▲ WHEN white settlers first came to South Africa, the dry plains were covered with vast herds of antelope. Remaining wildlife is now seriously threatened. *Left:* springbok; *center:* white-tailed gnu, or black wildebeest; *right:* blesbok

slow rate of reproduction. The other is the very high degree of specialization achieved by all known species. "Some species require a high degree of shade and humidity," said the British scientific publication *Nature*. "Some are confined in their distribution to riverbanks and streams. Others require dense shade and are limited to forests; again, others prefer more open parkland." This specialization suggests several means of controlling the various species, but many methods have been tried, and most have been abandoned as impractical.

Much of the bitterness against the fly is attributable to the many tragedies it has brought to frontier stockmen. The High Commissioner of South Africa at London, Heaton Nicholls, recently described attempts of settlers to start a livestock industry in Zululand, northeastern Natal, after the first World War. Cattle died by the thousands from nagana, and many of the farmers went broke, he said. Other

accounts said that the farmers, suffering at the outset because of the partial depletion of their herds by nagana, forced partial extermination of the game in near-by Umfolozi Reserve. Once the game disappeared, these reports said, the tsetse, far from conveniently dying out, left the reserve and concentrated on the susceptible livestock herds in earnest, wrecking many a farmer's hopes.

Extirpation of the game in many areas of southern Africa was accomplished haphazardly, as a natural outgrowth of the expansion of agriculture and in accordance with no predetermined plan. But many persons noted that when the game went, it took with it the dreaded tsetse. And in what will probably become the Empire's next dominion, Southern Rhodesia, where the Matabele wars took place a scant 50 years ago, a calculating, methodical plan for wholesale game extermination was conceived as the best means of controlling tsetse.

That this program was effective in controlling at least one species of the deadly *Glossina* is undoubted, and that it is as yet the only tried and true means of doing so is equally true. But farseeing scientists and nature lovers, noting the influential lobbying for extension of this drastic scheme through all British Africa, have fought bitterly, urging that more time and money be devoted to research. Their job is enormous and it may be impossible.\*

But the British are the world's most determined and practical conservationists. They are gradually rousing to meet the threat, although as yet with too little. Many naturalists fear the effort is too late. In no other country has a similar problem ever been satisfactorily met. Witness the fate of the bison in the United States and of the vicuña in South America. In Africa the problem is still more pointed and difficult, but the rewards for

\* As this article goes to press, announcement is made of a new drug, antitycide, which is claimed to cure Trypanosomiasis in cattle and to safeguard healthy animals by injection. This is an example to reinforce our trust in science. But there is no prospect that this particular discovery will promise greater security for wildlife, and cautious scientists are inclined to await further tests of its value.—ED.

success would be infinitely greater. It is one of the miracles of evolution that the incredible richness of the animal life of Africa was spared to modern man. To shoot such a divine gift into oblivion without making a strong effort to find some other way to control disease-bearing flies would be a hideous mistake.

"Beyond the human inhabitants there will remain, one hopes for centuries to come, the wild animals which make [Africa] so attractive to the lover of nature," elder statesman Jan Christiaan Smuts, said at Oxford eighteen years ago. "I look forward to the time when the rage for destruction will have disappeared, when the senseless slaughter of wild fauna will be as criminal and contrary to public opinion as cruelty to humans . . . Africa will be a place of refuge, a temple set apart where the human spirit can once more practice nature worship and enjoy peace and quietude." Less than a score of years later the

fauna of Africa were facing their gravest threat!

The *Times* of London, a publication great enough to realize that the preservation of the animals of Africa is vital news today, recently devoted two half-columns of its critically short newsprint to an editorial-page discussion of the problem. The anonymous article inspired a series of letters from the *Times'* remarkable circle of readers.

"Because of the vaunted success of butchery in Southern Rhodesia, game extermination is being vociferously and influentially demanded in the British colonies of East Africa," the *Times* article said, but it recognized that "the tsetse fly presents Africa with a problem which must be solved in the interests of human health and the health of domestic cattle." The fly is extending its range into many areas where it previously was unknown. In a letter to the newspaper Elspeth Huxley, born in Kenya and a well-known woman writer on

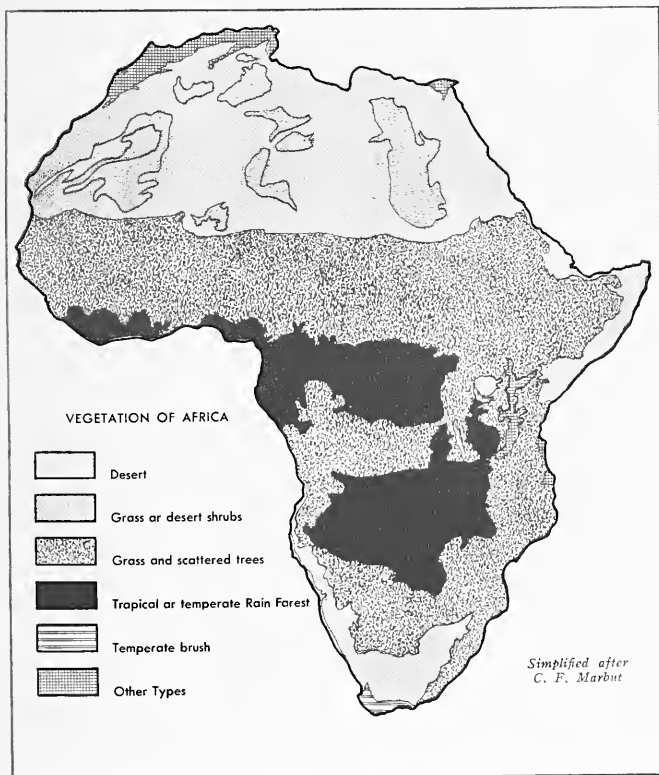
African affairs, warned that it "is advancing almost everywhere and in Uganda is threatening the very survival of the livestock industry. Seven-eighths of Tanganyika and three-quarters of Uganda are now said to be unsafe for domestic animals." The *Times* admitted that it was a most complicated problem but was reluctant to concede that its solution lay beyond the capacity of intensive scientific research.

Most widespread is the fly called *Glossina morsitans*. It is found in Kenya and is the main tsetse species in Northern Rhodesia. It is common in Tanganyika and has also reached Uganda. Almost as widespread are *G. palpalis* and *G. tachinoides*. All three transmit both human sleeping sickness and nagana.

But many authorities agree with entomologist W. H. Potts, director of a small tsetse research station at Shinyanga, Tanganyika, that the fly is "being used as a stick to beat the game." The bitterness of the struggle between the conservationists and the destructionists was reflected in letters to the *Times*. The slaughter of game was categorically supported by Professor Patrick A. Buxton, Director of the Department of Entomology at the London School of Hygiene and Tropical Medicine: "Game and cattle are incompatible," he declared, "and this would be so even if there were no tsetse." An acknowledged authority on the insect, he discussed *G. morsitans* at some length.

"Evidence of the dependence of *G. morsitans* on game is conclusive," he wrote. "For instance, if mining or road traffic disturbs game, the animals retreat, fly going with them. Outbreaks of rinderpest have more than once exterminated game over wide areas, and this insect with the game . . . Southern Rhodesia has used game destruction against this species of tsetse for a number of years. They have cleared about 6000 square miles (and have 4000 nearly clear) and have cattle on it, which could not be there if fly were present."

Professor Buxton's letter was sharply answered by elderly, genial Doctor Henry G. Maurice, world-renowned naturalist and President



of the London Zoological Society at famed Regent's Park Zoo. Normally an amiable man, Doctor Maurice felt no inhibitions about assailing "that assurance of infallibility which the professorial chair sometimes engenders." Dr. Maurice remarked that "the professor is careful to confine his observations to *G. morsitans*. He thus avoids the necessity of referring to the results, fatal to valuable herds of cattle, of game destruction in Umfolozi, where the tsetse involved is *G. pallidipes*, or to the complete failure to eradicate the same species by game destruction in Rhodesia itself . . . In fairness, one thing must be said for the execution of the game slaughter policy in Southern

Rhodesia. It is thorough and intelligently methodical, not senselessly sporadic. But whether it has really achieved or is achieving its object, it is too early to say. Whether it succeeds is not the question posed by those who wish to conserve the beauty and grandeur of African wildlife. The question is whether it is necessary, and whether the eradication of the fly . . . cannot be achieved by other means. [The *Times*] correspondent advocated scientific research in which, apparently, Professor Buxton takes no interest."

Dr. Maurice mentioned several experiments on methods of control. In one instance, he said, bush clearing alone stopped a "broad advance

of tsetse which had driven 30,000 Africans from their homes." Combined bush clearing and controlled grass fires once cleared tsetse from 1000 square miles with no game slaughter involved, he said. In still another test, grass fires were kept out of a controlled area and the tsetse population was reduced 95 per cent.

"It would be an impertinence on my part to yield to the temptation to discuss Professor Buxton's philosophy of life," Doctor Maurice concluded bitterly. "He is a declared advocate of uncontrolled shooting by Africans . . . Unlike the professor, I believe that man has everything to gain and nothing to lose by endeavoring to keep alive, not in glorified zoos but as widely and as freely as possible, those creatures of nature which are, in the main, so much more

▼ THE IMPALLA, noted for making extraordinary leaps when alarmed. This graceful African animal prefers parklike forests and is never found far from water

AMNH photo





AMNH photo

▲ WATER BUCK and a rare lechwe in the upper Nile: two members of Africa's incomparable wildlife, now threatened by civilization's advance

beautiful than man and so infinitely less destructive and vicious."

Almost everyone who has written on the subject urges further extensive research, but not much is being done. Mrs. Huxley, who understands the problem as well as any layman, wrote: "To drive out tsetse, game slaughter must be linked with control of the density of bush through clearing, burning, and other methods, a difficult and

costly business . . . There is, however, an alternative . . . [which is] to confer on susceptible animals the immunity acquired by game, or an imitation of it. This line of research is admittedly difficult." She said that so far as she knew, no such research was under way in East Africa. Mrs. Huxley visited the Shinyanga experimental station and complained that "this laboratory is staffed by [only] two scientists . . . and an assistant; they have no electric light or water and are obviously being run on a shoe-string."

Apparently it is only in the Union of South Africa that a serious attempt is being made to control tsetse while preserving the game. Doctor P. J. du Toit, Director of Veterinary Services for the Union, recently told a sizable crowd of interested scientists and laymen at London of a research program in Zululand involving extensive experimentation with the miracle insecticide, DDT.

An area was selected where the tsetse *G. pallidipes* was prevalent and where the cost of bush clearing would prove exorbitant. Fly traps were ineffective in controlling the insect, and hand spraying with DDT, while extremely costly, was

not efficient because the spray did not penetrate the foliage sufficiently. With the co-operation of the South African Air Force, planes were then used, operating like crop dusters. Six twin-engined Ansons, flying at 120 miles an hour 50 feet above the bush, laid long cottony streamers of DDT-laden smoke across the countryside. Some 50 acres a minute could be sprayed, and the cost per 100 square miles was about \$3.60 an acre. In places where ravines or rough ground made it unlikely that the area was covered thoroughly, hand-placed insecticide grenades finished the job.

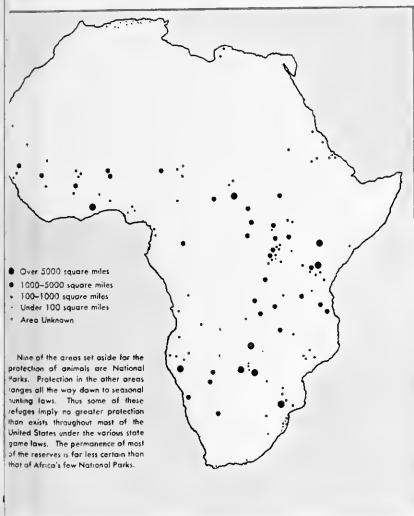
The flies were not wiped out, but the numbers remaining were very small. In view of their slow reproduction rate, they may have been brought below the "critical level" so that the fly might never be able to re-establish itself. The spraying was so successful that a temporary reprieve was granted immediately to animals that had been scheduled for slaughter, and within a few months it seemed likely that the reprieve would be made permanent. But it will take a year or more to secure the necessary evidence for a long-term decision on whether DDT can save the African game. At Shinyanga, cattle were sprayed with DDT and turned out to graze in a dangerous tsetse area. It resulted, said Caldwell, in a 90 per cent decrease in the fly, but the spray had to be renewed each two days. This worked out at an expense of about \$20 an animal a day, which was, of course, prohibitive. An emulsion that will stick to the animal for a considerable period has supplemented oil sprays in the United States. Occasional deaths among cattle sprayed with DDT in the United States have prompted caution in its use.

"Sufficient has been done to justify a tremendously increased scale of operations against the tsetse fly," commented *Nature*. "The amount of money spent on research has been . . . pitifully small in comparison with the harm [the fly] causes . . . Here is a problem which requires costly, large-scale research."

Concurrent with the spread of

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▲ MOPi,  
shark fisherman of the Tuamotu Islands

# The Man Who

How Mopi struggled with two  
sea monsters to pay off a debt

By WILMON MENARD

*Photograph by the author*

A FEW months before I came to the South Pacific coral atoll of Nukurua (Amanu), I witnessed a sight at the island of Rapa, to the south of Tahiti, that has made me a shark's enemy for life.

Frequently in the afternoon, off the headlands of the bay of Ahurei, Rapa, I would see schools of young whales, with occasional huge bulls. On this occasion, I saw two small whales, no doubt stragglers from the main school, tarrying and sporting on the sunlit surface of the ocean.

A native suddenly gripped my arm and pointed toward them, crying hoarsely: "Sharks!"

Rushing out through the headlands of the bay were countless sharks, swimming singly and in pairs. The young whales had been swimming over submerged coral ledges, scraping themselves as they went, probably to rid themselves of barnacles or other sources of irritation, and blood from the lacerations may have roused the sharks to special fury. In a minute or so the water bristled with the fins of the sharks as they closed in on the now startled young whales. Before the whales could sound, their flukes were ripped to pieces and their great bulks torn to shreds by the hungry, bloodthirsty pack.

Native divers, working pearl shell beds under water, have also been seized by sharks. Sometimes the monsters, with a mad wrench, strip off the skin and flesh, leaving lengths of white bone exposed. Several divers in the Dangerous Isles (the Tuamotus) with whom I have

talked have been attacked by sharks while descending, and the brutes have sheared off parts of their jaws and cheeks, leaving their gleaming teeth visible forever after.

But the most wonderful story in the Dangerous Isles is the tale of how a giant Tuamotuan, Mopi by name, rode on the back of a huge shark. French traders, schooner captains, and colonial officials verified the account, as follows. While gathering pearl shells under water at the pearl-diving atoll of Hikueru, Mopi bumped heads with a shark. The creature, fully twelve feet long, circled swiftly and attacked him. Mopi, caught off guard, was forced to seek refuge in a coral cavern. But the shark lunged in after him, and Mopi, seeing no escape, struggled desperately onto its back and buried his strong fingers in the wide, deep gills.

The shark, enraged and startled, headed with great speed for the surface. There the brute barrel-rolled and leaped clear out of the water with terrifying impact, trying to free itself of its rider. It suddenly shot to the bottom again, crashing wildly through brittle coral trees and slashing Mopi cruelly. Again it zoomed to the surface, blood gushing from its torn gills. This time it headed toward a submerged reef near the native village, and there it accidentally beached itself.

The villagers, who had lined the coral strand to watch Mopi's amazing ride, attacked the shark with spears and clubs. Mopi walked unaided to the beach, his entire body

torn and bleeding from the shark's rough skin and from collisions with coral. Then, seized with blind rage, he whirled around suddenly, ran back to the shark, and gave it a smashing blow on the snout above the jaws with his fist. But at that moment, the shark's jaws flashed wide—and Mopi's hand was gone!

I had always hoped to meet this extraordinary Tuamotuan, and one morning on Amanu my wish was fulfilled. A loud, yodeling call aroused me just after dawn, and when I stuck my head out of my palm-leaf hut, I saw a Polynesian giant standing beside a beached sailing canoe. He wore only a blue-and-white *pareu* tied around his strong, bulging loins. His muscular body was marked by long, serrated, livid scars, the telltale decorations of a veteran shark-killer. His head was massive, with tight, crisp ringlets of hair hanging low over his wide forehead. His eyes were large and liquid, tender though giving the impression of absolute fearlessness.

When he saw me, he grinned and waved gaily. His right hand was severed at the wrist.

"Ullo, big boy!" he cried in a deep, booming voice. "My name Mopi! I been Frisco! I walk down Market Street! Yah! *Vera ka hau!* Hot stuff!"

(Mopi had once voyaged to San Francisco on a copra schooner, and he had picked up an amazing vocabulary of English words.)

He rushed up to me and threw his injured arm around my shoulders in a rough hug.



# Rode a Shark



Drawing by John LeGrand

"I come Amanu. I hear you no like sharks!" he shouted, blowing fumes of coconut toddy in my face. "I say, damn hell to sharks!"

Mopi shared my simple breakfast with me, and not long afterward I had an opportunity to see him under water with sharks. We hurriedly launched the canoe across the lagoon and paddled to the foraging ground of the sea gangsters. The surface of the lagoon was unruffled, and the marine garden that spread out below us could be seen as clearly as if viewed under an immense magnifying glass. The sunlight was reflected from the coarse, sandy bottom and cast shadows in coral caverns where the monsters of the lagoon were possibly ensconced. Now and again a shaft of light would transfix the sliding body of a barracuda or a small lagoon shark or the green, slimy sheen of a twisting moray. It was like an amazing kaleidoscope.

When I turned around to speak to Mopi, who was in the stern paddling, I saw that he was affixing to his injured wrist a leather stirrup ending in a brass cap. In the center of the brass end was a threaded hole. He reached down, grinning, and lifted up an object wrapped in an oily cloth. When he

unrolled it, I saw that it was a long three-edged knife. This he screwed securely into the threaded hole of the guard.

He shouted truculently and waved it in the air. The canoe rocked suddenly, and Mopi was over the side, with hardly a ripple to mark his descent. Through the water box, I watched him go down feet first, the knife flashing brightly in the clear water. Then, at a depth of about ten feet, he turned and shot like a torpedo, head first, for the bottom. A huge shark was cruising slowly among smaller ones. The smaller sharks took instant flight, but the monster he had singled out circled him warily at a distance. Mopi swam toward the shark boldly, the knife-arm extended. The killer swam deeper, and Mopi followed him, until I could see only a shadowy outline of shark and man. A few seconds later, they rose higher, and I suddenly saw Mopi make a quick lunge at the shark.

Mopi's face was upturned now, and I could see that he was "making faces" at the shark. Then his fixed sword flashed out, and a small jet of gray smoke was ejected from the belly of the monster. (Blood in sea water at this distance appears gray in color.) The shark was furious.

It circled quickly and charged Mopi, who nimbly somersaulted, swam deeper, and then came up under the brute for another hard knife thrust. Again the native swam nimbly around a coral fan and pricked the thrashing, enraged shark. Then—danger!

A small though dangerous-sized shark came into the scene, attracted by the blood of the large one. It first saw Mopi and headed toward him; but the Tuamotuan was not to be caught napping, and when the small shark swam past, flashing its jaws for a bite, Mopi sank the knife deeply into its neck just back of the gills. The shark was moving away from him at the time and, by its own momentum, drew the knife out clean, without jerking Mopi around.

But the large shark was still to be reckoned with. It rushed in for a swift attack on Mopi, and the native jerked his body aside just in time to save his limbs from a cruel bite. Mopi apparently realized that with so much blood in the water he was exposing himself needlessly to danger, so he quickly reached out and grabbed a fluke of the big shark. He twisted his body under its stomach and, at the same time, sank his knife deeply into its belly. Then he released his hold on its fluke and allowed the force of the shark's motion to rip open its stomach.

The battle over, Mopi came to the surface, blowing his nose lustily. He was breathing in whistling gasps through his clenched teeth in the peculiar way of Tuamotuan divers, to relieve his strained lungs and accustom his lung muscles to normal action. Then he climbed unaided into the canoe, unscrewed his bayonet, wrapped it in the fish-oil rag.

He gestured down into the depths of the lagoon. "Now you do go down and give it to them."

I gave Mopi a long, dubious stare. "My good friend," I said, grinning, "when I want to cut short my life, I'll find pleasanter ways of doing it than rubbing noses with sharks!"

Mopi gave me a broad, under-standing smile. "Maybe you right."



Photo by Helen Lauder milk

# The Bug with a Crimson Past

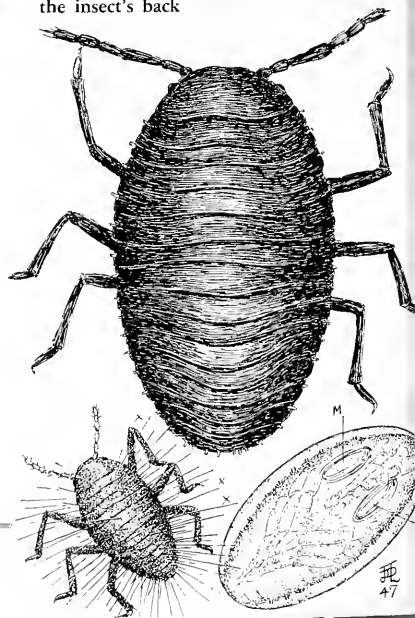
Source of brilliant carmine dye, Mexico's tiny cochineal insect started a fabulous industry that flourished for 300 years, producing one of the most romantic products of history

By JERRY LAUDERMILK  
Research Associate in Geochemistry,  
Pomona College  
Drawings by the author

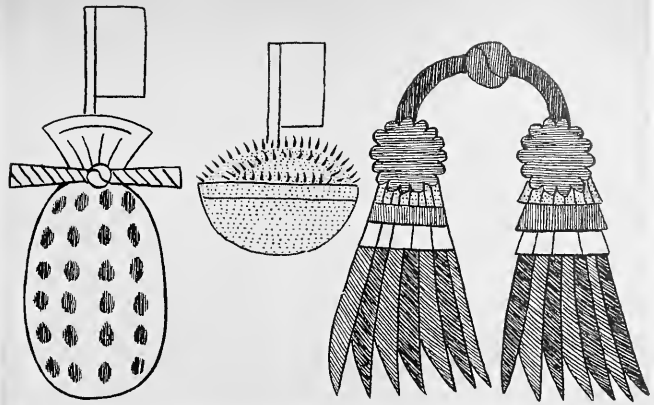
◀ **COCHINEAL PIONEERS.** This colony is just a few weeks old. Eventually the web will spread over the entire pad. Individuals have established themselves at the base of the spines, perhaps for protection of the young web

**T**HIS is the story of an insect that once rated an important place in the tribute rolls of an empire. One of the illustrations shows three curious hieroglyphics from an ancient Mexican manuscript wherein are listed the treasures demanded of the conquered states by the Emperor Montezuma. Scanned from right to left, they indicate: one gorgeous feather diadem made from the plumage of the quetzal; twenty gourds of gold dust (you can tell that the tally calls for this number by the flag stuck in the top); and twenty sacks packed to the brim with a curious article of commerce the Mexicans called *nocheztli*, meaning blood of the nopal, or prickly-pear cactus.

▼ **WILD COCHINEAL, *Dactylopius tomentosus*,** relative of the historic Mexican variety. *Top:* well-grown nymph highly magnified. *Lower right:* unhatched insect. The egg-shell has been cleared with a solution of KOH in glycerine. The coiled rings of chitin (M) later become the proboscis. *Lower left:* young nymph trailing filaments of wax (X) secreted by special glands on the insect's back



► COCHINEAL "MUMMIES," with gold dust and a feather crown, represented as treasure demanded by the Emperor Montezuma from conquered states. Aztec characters from the Mendoza Codex, in the Selden Collection, Oxford, England



The feather crown and gold dust are interesting because they show the sort of company our bug kept and because her own portrait is included. The rows of oval spots on the sack are stylized pictures of the contents—thousands of tiny, dark-red mummies of cochineal insects, source of the glorious crimson dye *carmine*, one of the most romantic commercial products of all time.

I had read of this cochineal insect, *Dactylopius coccus*, and the almost magical pigment made from it, in Prescott and other accounts of old Mexican civilizations, but it was not until I came to the Arizona Desert that I made the acquaintance of this insect's relatives. In some places in the south-central part of the state, the prickly-pear cacti were white with the webs or tents of *D. tomentosus* or *D. confusus*, both of which are abundant in southern Arizona and California.

Although the two cochineal insects found in the United States are not closely related to their illustrious Mexican cousin, it is interesting to examine them. Wherever the prickly-pear cactus (*Opuntia* of several species) grows, you are likely to find some of the pads disfigured or decorated—depending upon how you look at it—by the white rags and tatters of the cochineal web. This is a composite fabric spun from strands of wax and silk. To simply scrape off a wad of the stuff and expect to see the bugs inside is a natural but unsatisfactory way to get results. The big females, sometimes a quarter of an inch long, are deep inside the tent, and the sprightly youngsters, the *nymphs*, are tiny red specks that you might easily overlook unless you used a magnifier. But pinch a tuft of the web, and the carmine squeezed out will stain your fingers bright red. Add some cigarette ash, and the red is changed to a rich

shade of violet by the alkali in the ash.

The easiest way to unveil the insect population is to put a shred of web on a plate and add a drop of oil. This clears up the web in the same way that a spot of grease makes paper transparent. Now you will see bugs galore—red nymphs the size of microscopic dots and fat old mothers bigger than a match head. To see the inhabitants to complete satisfaction you need a microscope, which necessitates removing the web entirely.

Benzene takes care of the wax, and a solution of nickel hydroxide in ammonia dissolves the silk. This drastic treatment changes the population from inhabitants to specimens, ready to be examined under your microscope.

A low power, say about 20 or 30 diameters, shows the remains of what was once a teeming community made up of adults, nymphs, and eggs. (I'll not consider the case of the male bugs right now, since they lack an important feature that entitles them to a paragraph of their own.)

The eggs are tiny oval objects about an eightieth of an inch long. Since the shells are transparent, we can see the mysteries taking place inside. By selecting a series, we can follow the whole story of the bug's development from an unorganized emulsion to a larva ready to hatch.

As raw material for producing an insect, the contents of the egg seem at first to be as unpromising as a drop of mayonnaise—just a vast assemblage of oil droplets, particles

of red pigment, and a myriad of ultramicroscopic specks, all floating in a clear liquid. But older eggs begin to show the ghostlike outlines of transparent infant bugs, which take shape from the emulsion as stealthily as clouds from the air.

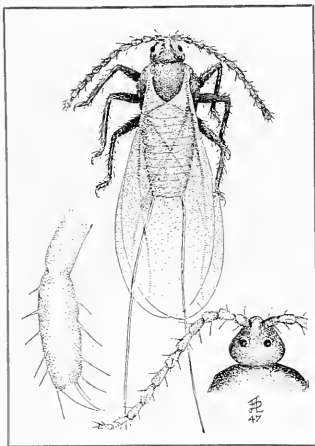
This marshaling to order of bug-stuff in response to some unknown urge within the fertilized egg proceeds unerringly, almost like the crystallization of a salt from a solution. From the start, these forming larvae show a striking feature: two circular objects that look exactly like loosely coiled rings of fine wire, one on each side of the embryonic insect's head. This is the beginning of the beak, which in the adult is an apparatus something like a built-in soda straw with a sharp point. The outlines of the embryonic bugs become sharper and sharper until the egg finally contains a neat little bundled-up insect, like the one shown in the drawing. This series, showing the development of an insect from the raw material to the finished product, makes an awe-inspiring and tremendously fascinating show.

When the egg finally hatches, the infant cochineal has embarked upon the second stage of its career. It is now a nymph, a leggy little midget which is best observed alive as it prowls among the filaments of the web. The microscope shows the nymph's outer covering to be furnished with some extremely curious organs. First there are the organs of touch, the *setae*. These are short, cylindrical, stubby-looking objects arranged in six rows



◀ A FULL-GROWN MOTHER COCHINEAL ready to lay her eggs. She is now merely an overstuffed sack with undersized legs, beak, and antennae—and packed full of eggs

▼ ADULT MALE COCHINEAL (top), *Dactylopius tomentosus*. Lower right: the head from beneath showing the lower pair of eyes. The other two sets are located on the top of the head (center figure) and at the sides (not shown). Lower left: the foot with its single claw, a typical feature. All figures greatly magnified



down the back, with six setae to each segment. Look a little closer and you will notice groups of small circular objects that look like pores. These are the openings—nozzles, you might say—to the cells that secrete wax, and through these the waxy threads flow out in somewhat the same way that tooth paste emerges from the tube.

These nymphs are decidedly different from the classic variety, since they are of both sexes. They all look alike at first, but each time they molt—and they shed their skins about four times—their similarity decreases. At first the nymphs stay in one place and gorge themselves with sap. This heavy feeding causes them to grow rapidly, and they soon settle down to being cochineal insects in a serious way. The males lose their nymphlike features and spin tiny white cocoons, in which they molt two or three times more—something like dressing in your sleeping bag.

The female nymph spins no cocoon but also molts, and with each change of costume she becomes plumper and plumper. With her last change, she becomes simply an egg-laying machine and looks a good deal like an overstuffed cushion. This is her final appearance as an individual. Her next role is that of an efficiently packed egg case, and I mean just that. What was once the skin of the mother is now a sack filled with eggs.

The remarkable characteristic of

the male cochineal is the feature it lacks. His mouth parts are undeveloped, and during his entire life span such prosaic activities as eating and drinking are impossible. But this is really a matter of small importance, since he leaves his cocoon charged with enough energy to carry him through his entire career. The males are hard to locate. In the first place they are scarce, being outnumbered by the females by about 200 to 1. In the second place they are small, only about a sixteenth of an inch long. Although they have bright red bodies, they are practically covered by a pair of delicate white wings, neatly folded down the back and matching exactly the white background of the web. Although nature neglected the mouth, she furnished the male with three sets of well-placed eyes. He has one pair on top of his head, another on the

sides, and the third underneath, in about the same position they occupy in the human face. Finally, two long, flowing streamers of white wax, which appear to be entirely ornamental, are attached to the terminal segment of the abdomen.

The wax web is the only protection that the cochineal has against its enemies, which include ants, beetles, field mice, birds, and a slick, pink grub that resembles the larva of a ladybug. The pink grub is the most dangerous of the lot, since it is able to deal with the baffling tangle of sticky threads which is a regular snare for other tiny marauders. The grub mines deep into the web, where it preys off the helpless, overstuffed mothers.

Through a microscope, an old cochineal tent is a wilderness of horrors, for it is littered with dangling skeletons of ants and spiders, the armor of departed beetles, dilapidated cradles (abandoned cocoons), and ragged old clothes (molted skins). Birds and mice learn to leave the webs alone, because bills and teeth gum up so thoroughly on the wax that the bugs are not worth catching.

This short survey of the personal history of the cochineal bug brings us to the next phase of the subject, the reason why *nocheztli* held such an important place in the culture of Mexico and elsewhere.

Normal folks like color in their surroundings, and the fact that colors have an effect upon the emotions has been known for ages. Shades of red, orange, and yellow stimulate. Blues and violets have a serene effect. Greens and cool grays relax the nerves, while drabs—dull browns and black—are sobering or depressing. Some shades of red are always a leader in a color scheme, and their presence or absence is usually noticed. Weavers, dyers, and painters have constantly been on the lookout for new shades.

For centuries, possibly thousands of years, the craftsmen of Asia and Europe understood the secrets of making several shades of red dye. Some of these were actual chromatic "knockouts," although prepared from curious raw materials. One beautiful red was produced by

kermes, an insect (*Coccus ilicis*) living on certain species of European live oak, particularly in Spain. It produced what was known as *granum tinctorium*, or red dye. The kermes insect could be gathered only with difficulty, but in early times many of the inhabitants of Murcia made a precarious living by collecting it. It had to be scratched from the twigs with the fignails, since any other means was said to damage the product.

Kermes had long been known to the eastern races, especially the Phoenicians, who knew the dye under the name of *thola*. Since this was one of the finest dyes of ancient times, it is generally believed by students of the subject that the scarlet used by the Hebrews for dyeing the curtains of the tabernacle was kermes. The name kermes itself is Arabic and is the source of our own word *crimson*.

Another powerful red dye of

ancient times was the Tyrian or Imperial Purple of the Romans. This was produced from two species of shellfish by a difficult and smelly process involving the use of steam heat. The color ranged from amethystine violet to true purple, producing a shade of red so deep that, like the reds of some roses, it looked almost black unless held at certain angles to the light. This dye was so tremendously expensive that a pound of wool dyed with it cost the equivalent of \$235.

Among the other red dyes was *madder*, produced from the root of three or four common plants growing from eastern Europe to the Far East and related to our common weed, bedstraw. This was one of the cheap reds of olden times, a loud, red-flannel red of about the same shade as our modern Turkey red.

So, as matters stood at the beginning of the sixteenth century, the known possibilities for preparing satisfactory red dyes from the materials then available in Europe had been exhausted. The technical processes for using the old dyes had long been mastered, and perfect fastness to light and water was the rule. Some of these dyes were so



Photos by Helen Lauder milk

▲ COLLECTING SPECIMENS of *D. tomentosus*. Nymphs are brushed into the beaker with a squirrel-tail brush

► OLD COLONY of cochineal insects on cactus *Opuntia vaseyii*. The white web protects thousands of the insects during all stages of their development



good that early Coptic yarns (fourth to seventh century) and later Flemish yarns (fourteenth century) have decayed without the colors fading. But then as now, experts in the dyer's art were ever alert for new shades and sources. A fresh field opened up in 1519, when Cortez invaded Mexico.

One of the many aspects of Mexican life that profoundly impressed the *conquistadores* was the vast size of the *tianguetz*, or great market of the Mexican capital. Here, among other strange articles of merchandise, were bales of cloth so finely woven and brilliantly dyed that they brought to mind the silks the Spaniards had seen in the markets of Granada. Much of this cloth was cotton, but there were also mantles woven from extremely delicate yarns spun from rabbit fur and dyed a powerful, soul-stirring crimson. This was, of course, the carmine dye of the cochineal.

Here, obviously, was a new product with great commercial possibilities, and samples of the new dyestuff were sent to Spain. By about 1523, the Spaniards in Mexico were shipping home as much of the cochineal as they could possibly obtain.

Now, although the Aztecs used the dye with complete success on their fabrics of rabbit fur, it was only fairly satisfactory on European wool. However, cochineal had points in its favor. For one thing its tinctorial power was ten times that of the old kermes. So for more than a century after its discovery, cochineal was the subject of much trial-and-error experimentation.

As with most other natural dyes, the secret of success lay largely in the mordant or "chemical go-between" that precipitated the pigment on the fiber in an insoluble condition. With kermes, the mordant was alum; other dyes required ammonia, salts of iron, tartar, borax, etc.; but alum was one mordant of wide application. Attempts to make a satisfactory cochineal scarlet with any of the mordants in use at the time was only fairly satisfactory. All this changed about the year 1630 (some authorities say 1650), when, as the result of a lucky acci-

dent, the Dutch experimental chemist, Cornelius Van Drebbel, discovered that the proper mordant for cochineal was tin oxide. This mordant is prepared by dissolving tin in aqua regia, a mixture of nitric and hydrochloric acids. When this "tin salt" is added to a cochineal dye bath and the solution boiled, tin oxide is precipitated, carrying the coloring material—carminic acid—along with it. A chemical attraction between the wool fibers of the yarn and the tin oxide causes the pigment to become permanently entrenched, so that the dye is not just a weak, superficial stain to wash loose with the first touch of water.

This discovery was the making of cochineal. It had "made good," and soon after, the dessicated bugs were being shipped from Mexico in great quantities.

There was still much mystery as to the actual nature of the dyestuff itself. Most folks were sure that the tiny dry grains were a seed of some sort. Others contended that it was a dried berry. A few thought it might be a dried insect. The credit for clearing up this point is generally given to the Dutch microscopist, Loeuenhoek, who settled the question in 1704. But Dr. John Hill, who published a work on natural history in 1752, said that a couple of merchants who dealt in the dyestuff had an argument concerning the actual nature of cochineal and finally bet on it. The point was decided on the sworn testimony of observers who had seen cochineal prepared in Mexico. Dr. Hill himself had some peculiar ideas on the subject. He said, "The male is a kind of little fly while the female is a *reptile* without wings."

Within a short time, cochineal was being raised in Spain, Italy, North Africa, and other countries where the nopal cactus could be grown. All one needed to begin cochineal culture was a stand of cactus and a few hundred healthy insects. You fastened small fiber baskets, each containing about a dozen egg-filled mothers, to the sunny sides of the pads. In about three months the nymphs would

be well grown but not yet at the web-making stage. Then one sunny morning when atmospheric conditions were favorable, you took a brush made from a squirrel tail and carefully swept the nymphs into a sack. The bugs were sometimes finished off by plunging the sack into hot water; this made *grana nigra*, or black cochineal. In making the best quality—*cochinella jaspeada*, or silver cochineal—the insects were killed by dry heat in ovens. The final treatment consisted of drying the dead insects on sheet-iron plates in the sun, producing the effect we recognize in the symbolic Aztec portrayal of red spots on a white ground.

The cochineal industry flourished for almost 200 years. It was established in the Canary Islands in 1826 and reached its height there between 1831 and 1874. As late as 1871, cochineal was being produced commercially from local bugs in California and New Mexico. But in 1874, the new aniline reds, easier to prepare and almost as brilliant as cochineal (though not so permanent) practically crowded the natural dyestuff from the market. But the bugs still held on for certain specialized uses.

Cochineal bugs are still raised commercially in the state of Oaxaca, Mexico, and some are grown in India, since there is a constant but moderate demand for carmine. Chemists have duplicated practically every other natural dye from coal tar, but to date this is one substance that has defied synthetic duplication. Probably the bulk of the carmine produced today is used for making artist's colors and for coloring foods, drinks, and cosmetics. But a good deal is used in the fields of biology and histology, where carmine serves as a stain to bring out the structure of certain types of animal cells and tissues. It is a far cry from the crimson robes of Montezuma to the coloring in grandmother's candy—but that is the romantic history of carmine. So in memory of *nocheztli*, whose color has charmed for ages, spare the bug a thought the next time you see a cactus pad flying the white flag of *Dactylopius confusus*.



# White Orchids

## from Cuba

The delicate flowers were like snowflakes in the hot jungle—and almost as unexpected

RECENTLY, while collecting plants in northern Cuba, I had the opportunity to pay a rather protracted visit to the little-known island of Cayo Coco, one of several hundred comprising the Archipelago de Camagüey. I knew that botanists who had explored the northern portion of Cuba had largely neglected Cayo Coco and that almost anything I might find there would be of great interest to plant science.

This definitely proved to be the case. Several new records were established, and a few new species are anticipated when the systematic examination of the collections is completed. One interesting discovery was a charming white orchid, never before recorded from this section of Cuba.

I had spent a wearying day, plowing through seemingly endless scrub thickets and falling in and out of obscure pits in my search for interesting plants, and was at last making my way through still another dense jungle in the vague direction of the pounding Atlantic, which I could hear far off. My companion and fellow collector, Bill Osment, had pushed ahead a bit while I paused to examine some nice clumps of a big *Polystachya* orchid.

A loud shout from Bill brought me to my feet, and as I crashed through entangling vines and tore my already gory arms and hands on the noxious spinose bushes so typical of this part of Cuba, I drew near enough to understand his words. He had found some white orchids!

Since we were particularly interested in orchids and had been assiduously studying every one we could find, this sounded most intriguing. Furthermore, I could think of no white-flowered orchid from this part of the island, so I was puzzled as to its identity.

At last I pushed my way through a particularly dense growth and be-

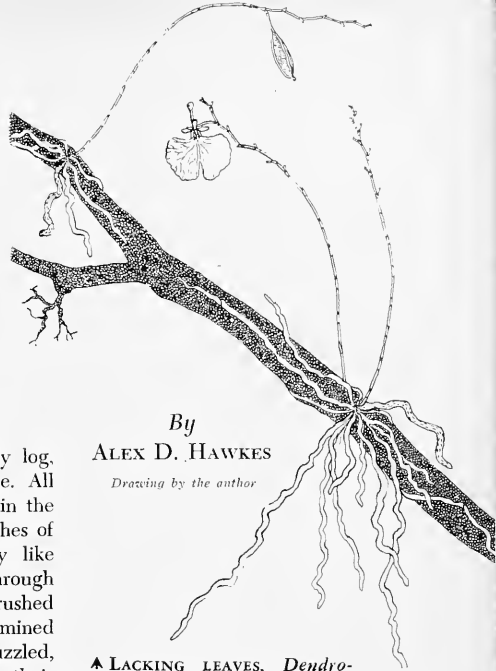
held Bill, seated on a mossy log, placidly smoking a cigarette. All around him, waving slowly in the hot moist shade, were splotches of pure white, looking exactly like snowflakes dancing down through the tropical air. When I rushed across to the orchids and examined them closely, I was still puzzled, but by a process of elimination their identity at last began to dawn on me. They were the elusive *Dendrophylax*!

Known to botanists as *Dendrophylax varius*, this beautiful orchid has a rather extensive distribution in both Cuba and the neighboring island of Haiti. It has been known since 1703, when the pre-Linnaean botanist Plumier described a weird "parasite" from the Indies under the name *Helleborine aphyllus, flore luteo*. It has since been renamed by several scientific students, and its presently accepted name was given by Ignatius Urban in 1918. The small genus to which it belongs is restricted to the Antilles and is placed in the subtribe Sarcantheae.

The flowers of this orchid are borne on a long, often curved stem and are usually produced singly or very few at a time but over an extended period. They measure only about three-quarters of an inch across and are pure, shining white, except for a minute blotch of brilliant yellow in the throat. The flower stems emerge from the center of a radiating mass of slim, grayish-green roots, the only vegetative parts the plant possesses. Vestigial leaves and stems may be present in immature seedlings, but they attain a size of only a few

By  
ALEX D. HAWKES

*Drawing by the author*



▲ LACKING LEAVES, *Dendrophylax varius* depends on specialized roots

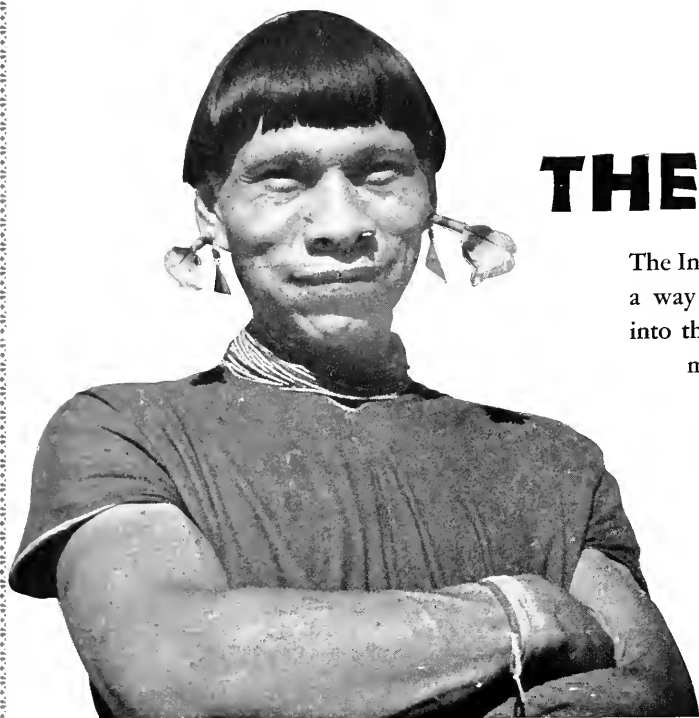
millimeters at best and are quickly lost. So this plant may be numbered among the "leafless" orchids—a strange clan, indeed! Their usually flattened roots, acting like leaves, are furnished with infinitesimal pores, through which the gases required in the photosynthetic processes are introduced and expelled, and thus they manage to survive and grow!

In the dark, damp Cuban jungle this delicate orchid has found a perfect natural greenhouse offering the conditions usually needed by plants such as these. Upon search of the vicinity, we discovered that the little white blossoms were everywhere about the trees, often in sufficient quantities to make a magnificent spectacle.

Approximately 200 species of the orchid family are included in this group of "leafless" orchids, their range extending into both hemispheres in all the tropical and subtropical regions. They are mostly small plants, usually bearing insignificant flowers; but some, such as our delightful little Cuban *Dendrophylax*, are well worth introducing into the collections of orchid enthusiasts, though their culture is bound to be difficult.

# THE Bitter

The Indians of tropical South America found a way to change a highly poisonous plant into their chief food throughout an area of more than a million square miles



▼ CASSAVA is a member of the Euphorbia family and is thus related to the rubber tree (*Hevea*) and the castor oil bean

▲ A CASSAVA EATER of the Macaguae tribe: a man with pierced ear lobes, a necklace of beads, and a *cushma* of cloth obtained from traders

finally, his entire agriculture will revolve to a large extent around the cassava grown in the clearings that he has carved out of the jungle. Bitter manioc is the most important single crop grown in the Amazon basin.

Cassava has many names—manioc, yuca, mandioca, manihot, casabi, rumu—almost as many names as there are languages in South America's Amazon. Yet no matter what it is called or how many varieties seem to exist, all are closely related members of the genus *Manihot*. And bitter manioc is surely one of the world's strangest food plants, for in its native state it is poisonous. Its fibers contain one of the deadliest poisons known to nature—hydrocyanic acid. Yet this root is food for countless thousands of Indians, of infinite tongue and name, and from cassava comes food we ourselves use almost daily on our own tables.

No uncultivated prototype of the cassava plant has yet been found. As grown by the Indians, it is a graceful, delicate-looking plant, its slender gray stems supporting compound leaves with 5 to 7 leaflets. It grows more than head-high. When the plant is pulled up, one is amazed to see the large tuberous roots on so delicate a stem. Shaped like a sweet potato and covered with a brown, almost barklike integument, the enlarged root may measure two feet in length and weigh as much as two pounds! Botanically cassava belongs to the important family named the Euphorbiaceae (after the Greek phy-



BRILLAT-SAVARIN, the playing author of that famous treatise on food, *La Physiologie du Gout*, put the whole matter of taste and tasting in what he considered a gastronomical apothegm. "Tell me," he wrote with his quill feather, "tell me what you eat, and I will tell you what you are." Now, contradict Monsieur Brillat-Savarin as much as you like, still he is most certainly correct in respect to the Cassava Eaters. For an Indian who eats what is known as bitter manioc has a whole culture, a whole way of life predicated on his food. Any anthropologist can depict at once the broad outlines of his life: he will be a jungle dweller in tropical South America or, formerly, in the Caribbean Isles, and he will travel about naked or almost naked. He will have, with little variation from tribe to tribe, the same type of instruments to convert this cassava into a digestible sustenance; and,

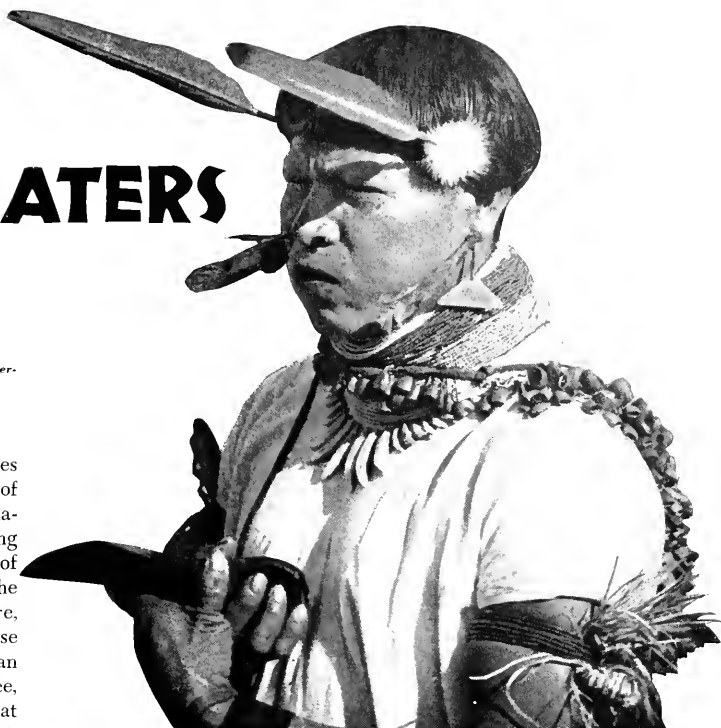
# Cassava EATERS

By

VICTOR W. VON HAGEN

Photographs by the author except where otherwise credited

sician Euphorbus), which includes some of the most contradictory of plants—the brilliantly-colored ornamental croton, the latex-yielding Hevea rubber tree, that scourge of childhood the castor-oil bean, the poinsettias, and, closer to us here, the many spurge. Many of these euphorbiaceous plants yield an acrid, milky, often poisonous juice, so it should come as no surprise that the bitter cassava (*Manihot utilissima*) has, under its barklike skin and permeating its fibers, a high percentage of hydrocyanic or prussic acid. However, it is surprising



▼ A COMMUNAL HOUSE of the once great Macaguajes in Columbia, one of the many tribes relying upon bitter manioc for sustenance

▲ A MACAGUAJE CHIEFTAIN, contemplating the acquisition of an axe blade in exchange for his blowgun





▲ AFTER being peeled, the roots are grated. This Macaguaje woman is preparing graters made of spines of the chonta-ruru palm inserted in a wax-filled board. Formerly, some Indians even used diamond chips



▲ SWEEPING the soggy, freshly grated cassava into part of an old canoe

that the Indian should have discovered methods to rid it of its poison and convert it into food. Strange, too, for there is a non-poisonous species of cassava, known to botanists as *Manihot aipi*. This is used by the upper Amazonian tribes of Colombia, Peru, Bolivia, and Ecuador, as well as in Central America, but it is often grown side by side with the poisonous cassava.

Who are the bitter manioc eaters? All or almost all of the tribes of the Central Amazon, whether they be the Arawakan tribes of the Guianas, the Tucanoan of the upper reaches of the Rio Caquetá, the Mojo in Bolivia, or the remnant of the fierce Caribs of the Caribbean Islands. To these people, bitter manioc in one or another of its varied forms is the bread of life. Within this vast area, as large as the territory of the United States, whole peoples are dependent on it, so much so that one might say that their relation to this poison-filled tuber is symbiotic, for neither plant nor man can live without the other. Nor does the method of extracting the poison from the tuberous roots or its preparation differ much from tribe to tribe. To describe one is to describe them all.

In the beginning, as the authors of Genesis would tell it, there is the root. It is cut from the cassava by the Indian women, for they are the agriculturists; and the stem is replaced in the soil where it will soon develop another root system. Then the roots are taken to a stream, peeled of their brown bark-like skin, in which lies the greatest concentration of prussic acid. The second step is to grate the root, and the grating instrument differs considerably from tribe to tribe. The Macaguaje, one of the Tucanoan peoples of the upper Amazon (on Colombia's Rio Caquetá) make their grater from the iron-hard thorns of the chonta-ruru palm, imbedded into karamani, a wax with the hardness of cement. Other tribes in the lower Amazon use quartz flints, others diamond chips (indeed, the discovery of diamonds in cassava graters began the diamond industry in Brazil).

The grated, damp, soggy cassava



A.M.N.H. photo

◀ POISONOUS JUICE is squeezed out of the bitter cassava in the tubular basketwork container at right in this picture. The lever, locked in an appropriate notch, regulates the strain

▼ THE POISONOUS JUICE is collected in a bowl beneath the squeezer



mass is put into a basket-work cylinder, an apparatus some six feet long and three inches in diameter. A miracle of ingenuity, it is so woven that its diameter increases or diminishes when the ends are pressed together or drawn apart. It is constructed, if one's youth can be recalled, on the same principle as the finger toys once beloved by boys, from which the finger could not be pulled out unless the tube were first relaxed by forward pressure. These cassava cylinders are filled with the cassava mass and hung from the rafters. A stick passed through a loop of the press serves as a lever to elongate the press and squeeze the juice, poison-filled, out of the sieve-like openings of the apparatus. This liquid is caught in a discarded bowl and then carefully thrown away. However, in the West Indies it becomes, by primitive alchemy, a commercial product. Boiled (for boiling dissipates the volatile hydrocyanic acids) the juice becomes cassareep,\* and is used in the preparation of the famous pepper pots of Trinidad.

This third operation, squeezing out the poison-tainted juice, con-

verts the cassava into a coarse, granular meal; toasted it becomes the farina of commerce. Still another process can change it into tapioca† and other starch "thickeners." These are used so extensively in modern cookery that even to make a list of them would tax a Brillat-Savarin. But the Indians, at this point, put cassava meal through another process, which changes it into their food and also provides a convenient way of storing it. The granular meal is usually pounded in a mortar and sifted. Then the Indian woman puts a quantity of the material on a large, flat baking disk to form a giant cassava pancake, looking like an outsized Mexican tortilla. The heat drives off the remaining traces of poison, and the cassava bread is then laid in the sun and dried to the hardness of hardtack so as to resist the humidity of the Amazon. In this state it is ready to be eaten. It forms the major part of every meal. When dipped into their *olla podrida* of boiled fish or meat, it becomes less rocklike. Carried on the hunt, it can be broken up, reduced to coarse powder, and taken in water. Again, it is masticated



\*Cassareep from the Carib: cachiiri-poue, the juice of the cassava.

†Tapioca, a Tupi word meaning "absence of juice."

➤ AFTER squeezing, drying, pounding, and sifting, the cassava flour is baked in huge tortilla-like cakes like the one being formed here

▼ WHEN TOASTED, the gigantic pancake is placed on the rack to dry



▼ THEIR PLACE in the sun: cassava bread hardening and seasoning under the Amazon sun. If kept dry, this outstanding food of tropical South America will last for weeks, months, or years



by the women (chewing changes the starches into sugar), spat out, mixed with water, boiled, set aside, allowed to ferment, and, within thirty-six hours, it becomes a maltish-tasting brew. If drunk in Indian quantities—two gallons at least—it will have enough “kick” to create nightmarish visions.

Not that cassava is utterly unique. For if one were to enumerate the foods America gave the world—the potato, tomato, chocolate, lima beans, corn and squash—the list would extend through the greater part of our daily sustenance. But bitter cassava is unique in that it can only be made edible by an elaborate method of ridding it of its poison. Even a chemist will applaud the methods devised by the Indian for accomplishing this.



# AUSTRALIA'S

## Stinging Trees

Each hair is like a hypodermic needle equipped with a poison-filled bulb at its base

By G. H. H. TATE

Curator, Department of Mammals,  
American Museum of Natural History

NO one who has felt the intense pain caused by the sting of a stinging tree can forget the experience. The effect, when no more than a mere inch of skin has been brushed by the harmless-looking leaves, is agonizing. When, as happens every year in Australia, some heedless picnicker clad in summery garments trips and falls headlong among the myriads of minute venomous spicules, the result may be almost maddening.

In America many of us have come in contact with our insidious poison ivy, which often takes a full day before the irritating oil from its leaves gets fully to work. More rarely we have brushed against true stinging nettles—cousins of the Australian stinging trees—which, though they chastise us sharply for the familiarity, seldom leave an effect lasting beyond an hour. Nettles are not common in the eastern states, though I recall finding beds of them near Asbury Park, New Jersey; but in Europe they are found growing in every waste piece of ground. Children there almost all believe that the juice from the crushed leaves of common dock, *Rumex*, rubbed onto the affected place, quickly cures the nettle's stings.

As a most ill-conceived practical joke, foliage of a stinging tree was mixed with a bouquet of flowers and given to an Australian lady: "It brushed against my face. Next morning my whole head was swollen, and I could not see out of one

of my eyes for some days. The pain was intense, and with this added to the great heat at the time, I suffered far more than I cared to acknowledge."

Another, suffering from the effects of the stinging tree, referred to its disagreeable but warning smell (which I personally never noticed). He also wrote that though it leaves no mark, the pain is maddening, and for months afterwards the part is tender in rainy weather or when washing.

Mr. C. R. Brown, the botanist, was stung on the middle joint of the second finger of his right hand by a single hair of the giant stinging tree *Laportea gigas*. He described his experience quite objectively. For a minute, he said, he felt almost nothing. Then the skin started to itch and burn. In two minutes pains began in the joints of the finger and at the wrist. In five minutes the pain had extended up the arm; then it gradually spread down the right side of the body to the toes and up the right side of the head. The pain increased for half an hour, after which for two hours there was such numbness that he could not hold a pencil in his hand.

Various "bush" remedies are spoken of, among them applications of wet mud and the moist inner

A YOUNG, two-foot stinging tree, *Laportea moroides*, showing the red-dish-purple mulberry-like fruits from which it gets its scientific name

bark or cambium of the same stinging tree. Their value is very questionable.

Other creatures besides man may be stung. Horses are reported to be the most susceptible of all animals and are said to become virtually mad after getting into a grove of stinging trees that he rushed open-mouthed at everyone who approached him and had to be shot. In other cases, horses were reported so severely stung that their bodies and limbs became swollen.

Brooklyn Botanical Garden photo



and they had to be rested for several days.

An instance is reported of a stung dog rushing about, whining piteously, and biting pieces of skin from the affected part. Cattle, too, are said to become infuriated when badly stung.

The pain produced by the stinging hairs of Australian stinging trees is like that caused by touching very hot metal—even when the touch is quite gentle. Each hair is composed of a rather soft basal bulb containing the irritating fluid and a tapered hollow needle-like end. When freshly developed, this “needle” is tipped by a tiny rounded knob, which breaks off at the slightest touch and exposes the sharp tip. The hair in its entirety works rather like a hypodermic needle, provided with a poison-filled bulb at its base.

The pain-producing substance is generally said to be formic acid. The common nettle contains .002 per cent of formic acid, but the stinging tree contains in addition .179 per cent of free acetic acid. “Plant toxins” are said by one observer to be present.

There are at least three sorts of stinging trees in Australia, all belonging to the genus *Laportea*. The wood nettle, or Canada nettle, found in eastern United States, is a member of the same genus, but its leaves only sting mildly.

The three kinds of Australian stinging trees differ greatly from one another both in appearance and stinging powers. The first is the giant stinging tree, *Laportea gigas*. This huge tree, with a trunk several feet in diameter and buttresses placed with great regularity around the base, grows to a height of 100 feet. The bark is smooth and pale gray, the wood soft, fibrous, and juicy. When the tree is cut down, numerous suckers, each covered with big heart-shaped leaves, spring up around the butt. Cut sections, like pieces of sugar cane, root readily. The tree is common in the rain forests of northern New South Wales and southern Queensland. I saw it in Bunya National Park, west of Brisbane.

The second species of stinging

*Continued on page 131*

# Isbi - THE



When the ruthless frontier wiped out his tribe, he waged a lone battle for life in the California wilderness. But during his declining years he enjoyed distinction as a unique subject of scientific study on a university campus

By

W. H. HUTCHINSON

*All photographs courtesy University of California, Publications in American Archaeology and Ethnology*

◀ Isbi, the day after his capture, dressed in a borrowed slaughterhouse apron

THE mountain men who blazed the overland trails to California had a low opinion of the Indians they encountered beyond the high Sierra wall. They called them “Diggers” in derision and killed them as casually as they stepped on the ants that crawled across their path. Yet of all the proud Amerinds, from Iroquois to Apache, it was one of these despised people who resisted the white man the longest—for almost 25 years after the hot-eyed Geronimo surrendered.

You skirt his country now as you drive north from Chico along the

eastern side of the Sacramento Valley, on your way to Shasta Dam or Lassen National Park. The dry stream beds that underpass the highway are only names to the uninitiated—the hard, practical, Anglo-Saxon names bestowed so many years ago. There is Mud Creek and Rock Creek and Pine Creek and Deer Creek; and when you cross Deer Creek, your eyes lift unbidden to the great snow cone of Lassen Peak thrusting aside its crown of thunderheads.

Then you must forget the irrigation and the smell of green things growing in the valley to your left.

# UNCONQUERED



Then you must see, and most of all feel, the barren, arid foothill ridges lifting slowly on your right. It is a land of old lava flows, cut and canyoned by the streams you have crossed. It is a land of manzanita and bull pine and oak along the ridges, of canyons choked with peppertree and poison oak bushes six feet tall and strong in proportion. It is a wild and inhospitable land to this day, and few white men live in it by choice. When you live in it as I do, you know it for the homeland, the beloved country, of the last Stone Age man north of the Rio Grande to project himself into the twentieth century.

I was building a small diversion dam last summer at the head of Mud Creek, and in digging down to bedrock for the footing, I uncovered a chipped and broken arrowhead—not good flint or honest obsidian but shale, a poor substitute. With it I found a water-worked rock shaped by nature, with slight assistance, into the axehead shape that distinguishes Alley Oop. I took them home with me that night, and they sit before me as I write the story of Ishi, whose true name must forever be unknown. He was the last of his people, the sole survivor of over 60 years of unremitting warfare; and his greatest defeat—and final victory—came not from force of arms but from the white man's love of souvenirs.

Even before the Spanish came to California, more prolific tribes had forced the Yahi away from the fertile valleys along the main rivers by sheer force of numbers. The Yahi were crowded into the foothill country that no other tribe wanted, and the country itself, plus their warlike inclinations, kept them

down to what their country could support.

Only rarely, and then at the risk of pitched battle, did they make forays below the 1000-foot contour into the great central valley to gather grasshoppers and then singe off their wings and dry their bodies against the hunger of winter. They gathered grass seeds along the foothill ridges and followed the harvest up the slopes to Lassen Peak as summer ripened the higher elevations. They collected acorns in the fall, and these, together with the salmon that used to throng the Sacramento and its tributaries, formed their mainstay against the starvation that always threatened if spring were long delayed. They caught deer with snares, and with skin coverings and skillful bleatings they decoyed the game within sure arrow shot; and occasionally they killed a bear, the California grizzly. There was ever an economy of survival, and the white man tilted the scales against them with the finality of civilization.

The vanguard of white invasion

▲ HIS RUGGED HOMELAND: a view of Deer Creek Canyon, southwest of Mount Lassen

came down the Lassen Trail—the Emigrants Death Route to California—which ran down the dividing ridge between Deer Creek and Mill Creek. The immigrants had horses and mules and cattle that were more easily killed than deer and were just as tasty. Indeed, the Yahi quickly developed a mountain lion's taste for horse and mule meat, and these they killed by choice rather than the gaunted oxen. When the Lassen Trail was no longer used, the Yahi palate led them down into the valley, where the white man had subdued their native enemies, and they raided the livestock of the outlying ranches. To lose his livestock was more than enough to make the white man wrathful, but when the Yahi compounded the felony by murdering the white man and his family, it was too much.

By the time Ishi was born into this embattled people, about 1855, their tribal strength had already





◀ CLIFFS not far from Ishi's last village

been reduced below 300 souls by almost a decade of warfare with the American conquerors of California. Before Ishi was able to walk, he and his people had become a source of revenue to the settlers. A purse of \$3000 was raised by popular subscription for their extermination, and a Yahi scalp was sufficient evidence for payment.

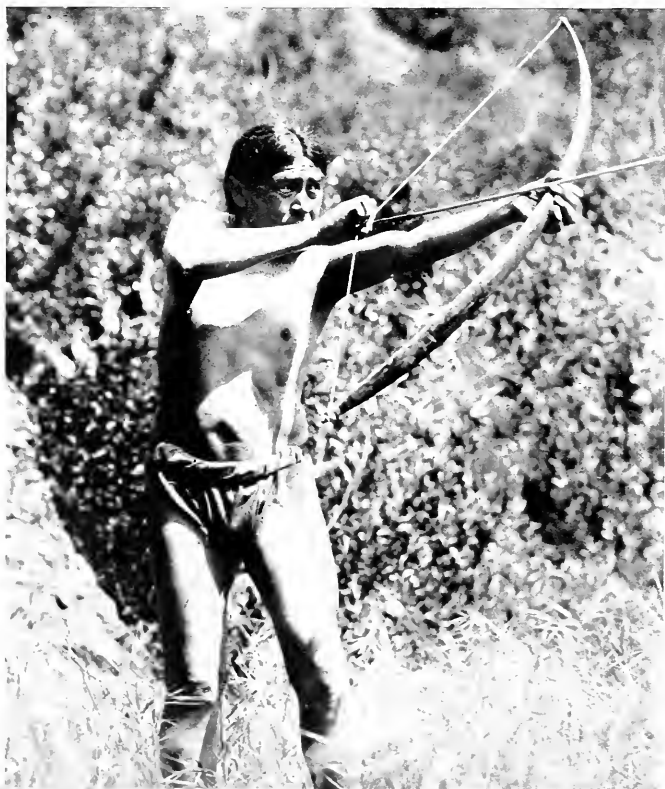
The Yahi did their best to even the score or get a credit balance, and they killed the white man's women and children just as savagely as the white man killed their families. Ishi had his first contact with the whites as a result of the murder of the Lewis children, to which was added the theft of Solomon Gore's horses. The settlers jumped the Yahi camp in the half-light before dawn, and the Yahi lost heavily until they scattered in obedience to the ancient principle that he who runs away may get a chance to even the score later on. The victors ransacked the camp, retrieving stolen property, and

when they kicked apart a heap of stolen quilts, a solemn-eyed boy about nine years old faced them stoically.

The settlers adhered firmly to the principle that "nits breed lice,"

and Ishi would have died then and there had not Bob Anderson intervened. Ishi was alive amidst the wrecked *campoodie* (native village) when his people returned to cremate their dead and to burn their hair down to the scalp in sign of mourning. It was a rite that was to become all too familiar to Ishi before he died.

The close of the Civil War was the beginning of the end for the Yahi. A fresh influx of settlers poured into the valley, men trained in four years of savage warfare along the Missouri borderlands. More and more cattle grazed over the ridges, and sheep and hogs were introduced to compete with the Yahi and the deer for the grass seed harvest and the acorn crop. Far away from the Yahi country, the great hydraulic monitors "piped" thousands upon thousands of cubic



► WHEN almost 60, he accompanied Dr. Saxton T. Pope, the archery expert, on a camping trip. He was the only person to bathe every morning in the icy waters

► VIEW across Deer Creek Canyon, last home of Ishi's people

yards of gravel into the streams of the Mother Lode. Their "slickens" clogged the Sacramento, and the salmon run fell off along its upper tributaries. But Ishi and a few of his kin lived and grew wise in the desperate art of sheer survival.

Finally in 1870, Ishi came face to face with the hard facts of Yahi life. His ear lobes were pierced for ornaments, and the septum of his nose held a polished bone except when he had a cold. Then it held a sprig of juniper or bay, which acted as a primitive inhaler. He was in his middle teens, admitted to the status of a man, but there were no marriageable women left alive. It is doubtful that Ishi wasted much time bemoaning his celibacy; he didn't have the time for this luxury. The burden of food-getting was falling more and more upon his shoulders, and with his father's increasing age and feebleness, the tasks of successful leadership also devolved upon him.

In this same year, two of his sisters were captured by the whites. Ishi followed them until the approach of open country made concealment impossible; then he watched them disappear into the heat haze of the valley to end their lives on the reservation of an alien tribe.

Two weeks later, a settler named W. J. Segraves awakened one night to find the Yahi in his front yard. Segraves prepared to sell his life dearly and was understandably relieved when the men handed him their bows in sign of peace. Since the bows were too strong for him to unbend, Segraves broke them to make sure that the peace would be lasting, and the gathering spent the remainder of the night debating the formalities of surrender. After a breakfast off Segraves's cattle, provided willingly in this instance, the peace conference suddenly dissolved.

A neighbor of Segraves happened



to ride over to weigh himself. When he threw the rope of the steelyard over the limb of a convenient tree for this purpose, Ishi and his defenseless people, misinterpreting this as preparation for a hanging, scattered like a covey of foothill quail. Their one gesture of submission to the inevitable came to naught despite the best intentions in the world on both sides.

The following year brought disaster to the Yahi. They stole some beef cattle in Morgan Valley and failed to cover their tracks properly in their great haste to eat. Cowboys used dogs to find their hiding place in a cave under the overhanging banks of Mill Creek. They killed everyone they found, men, women, and children, although one of the pursuers did boggle at shooting the children with his .56 caliber Spencer rifle: *It tore them up so*. He managed to salve his conscience by using his six-shooter, which was only .38 caliber. Once again the word went out that the Yahi were exterminated, but when the cowboys returned to the cave with visitors, Ishi and the little band left to him had come back and cremated their kinfolk according to tribal custom.

The only course left to Ishi and the battered remnant of his people

lay in avoiding any form of public attention. He forbade stealing the white man's cattle; and any use of firearms was abandoned. The Yahi reverted to the bow and arrow, the snare and pitfall, to digging roots and spearing fishes as their forefathers. Ishi's only concession to the white man's civilization was to steal empty bottles; the glass fractured more evenly than the best flint and made the finest arrow points he had ever owned. In the ensuing forty years, Ishi lost only two of his people to the white man. In 1878, Rafe Johnson flushed two squaws out of an oak thicket, roped them both, and took them in to civilization.

Ishi had one chance, at least, to even the score ten years later when a white man crowded him too closely. D. B. Lyon was hunting deer on Antelope Creek when he heard a noise in a buckeye thicket and crawled in to investigate. He crawled out again with an arrow through his hat, not his heart, and with a firm conviction that he was a long way from where he should be hunting deer. Whether it was this incident or just the general pressure of settlement along Mill Creek that prompted the decision, Ishi led his people over the divide from their ancestral haunts into the

canyon of Deer Creek to the south, about 1890.

Deer Creek Canyon is wild and deep, carved hundreds of feet below the lava rock of Deer Creek Flats, and in a tangle of shrubbery below the mouth of Sulphur Creek, Ishi cunningly concealed his village. Here the remnant of the Yahi made their home, while the slow attrition of natural causes wore them down until there were but four of them left—Ishi and his immediate family, mother, uncle, and sister.

How long they could have survived their grinding fight against starvation must remain a matter of conjecture. In the fall of 1908, a utility company decided to survey the latent power in the rushing waters of Deer Creek. It was hard, hot, sweaty labor for the survey crew but no different from other such jobs they had done—until the afternoon of November 9, 1908.

Alf Lafferty and Ed Duensing were walking back to camp at dusk this day, and as they rounded a bend in the canyon, they saw a naked Indian holding a vicious, two-pronged spear. He snarled at them, so they thought, and Alf and Ed "made a crossing of Deer Creek where there hadn't been none before." The next morning, the entire survey crew armed themselves and started a reconnaissance in force, chopping out the brush as they went to form a line of communication or retreat.

They had not gone far when they brushed their way squarely into Ishi's last refuge—three small, A-shaped shelters of brush and poles, so cunningly concealed that they could not be seen from outside the thicket or from the canyon walls above. Stirring up a pile of deer-skins and scraps of canvas in one of the huts, they uncovered an ancient woman paralyzed with fright, and Miles Apperson gave her a canteen of water and left it beside her. Then the men helped themselves to whatever took their fancy—fire sticks and arrow-flaking tools, deer snares made of cunningly twisted milkweed fibers, the two-pronged fish spear that had scared Alf and Ed, and such oddments of

clothing as struck their fancy, including a cape of wildcat skins. After they had satisfied their hunger for these unique artifacts, the group went back to surveying, assisted on their way by an arrow from Ishi's bow that passed between two of them.

By next morning, their consciences had begun to twinge, and they went back to the camp with beads and other mediums of exchange. They were too late! The old woman was gone, and the camp had been scoured clean of every fragment they had left behind, although under a pepperwood tree they did find a pile of glass flakings that almost filled a bushel basket—the results of Ishi's arrow-making for many years past.

The news of "wild Indians" in Deer Creek Canyon prompted a search party very different from any that had sought the Yahi in the past. Professor T. T. Waterman, of the University of California, was in charge, and he was prosecuting a matter of great ethnological importance. If the "wild Indians" were Yahi, he could fill a gap in the mosaic of California's aboriginal population. The Yahi had been believed extinct for so long that they were an almost legendary people, and their language, customs, and tribal lore were completely unknown. Dr. Waterman and his party were men of good will, but they were too late. Ishi and his family had left the shelter of Deer Creek Canyon for the higher, unprotected reaches of the foothills. It was a bitter country in which to wage a winter fight to keep alive, and the odds were all against the last of the Yahi.

When Ishi's camp had been souvenired, it was too late in the year for him to replace his essential tools and weapons before snow flew; he had his bow and some arrows, that was all. The food they had already collected against the winter was safe, because it was ever the Yahi practice to conceal their food supply at a distance from their camp so as not to lose everything in a surprise attack. This scanty store became their emergency supply, to be used only when

Ishi failed as a hunter; and it was soon exhausted.

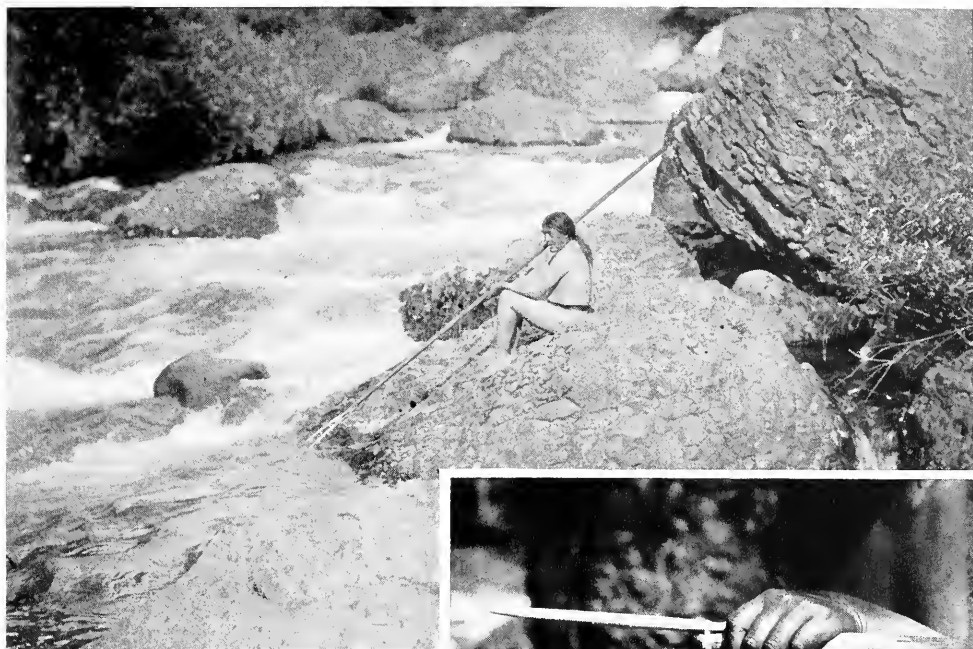
The full story of the next three years was never known, but early in their wanderings, the older woman and the old man drowned in fording a winter-swollen stream. The next winter the younger woman, Ishi's sister, died of pure starvation, and the coyotes ate her body before Ishi had a chance to cremate it. Once again he hunkered over a tiny fire and singed his hair to the scalp in sign of mourning. For another year he pursued his lonely search for food, a search that took him farther and farther away from the Yahi homeland and led him south and east to the corral of Charley Ward's slaughterhouse.

The abattoir stood outside of Oroville, near enough for economical delivery but far enough to avoid offense. The men who slept there were awakened one August morning in 1911 by excited yelpings in the corral outside. A figure crouched in the dirt, surrounded by a circle of wary and vociferous dogs. His fragmentary garment revealed more than it concealed, and around his neck was a small sack containing a few manzanita berries. Since all their efforts at conversation were futile, one of the butchers informed the Sheriff at Oroville that they had captured a "wild man." They knew he was wild because he couldn't speak English.

When the Sheriff's deputy arrived on the scene, he commanded a leather butcher's apron, threw it about the "wild man," and took him in custody. The best place to keep him seemed to be the insane cell at the county jail, then unoccupied, and there he was deposited but not without a rough friendliness and a sincere desire to make him comfortable. They overcame the technicality of how to book him properly by calling him "Panama Kid Webber," combining the Constable's nickname with the Sheriff's patronym. When it came to the charge, they were up against it, and he was never charged with anything more serious than being a "wild man."

When the story of his capture gained circulation around Oroville,





▲ CAMPING on Deer Creek with the white man: Ishi using a salmon spear he made on the spot



➤ A LESSON in survival methods: lashing prongs to shaft of fish spear

so many gifts of fruit poured in that the Sheriff had to make a public plea for their cessation—but not before Ishi had learned that a banana was peeled, a tomato was not peeled, and an orange was. When he sensed that there was nothing worse in store for him than a dry place in which to sleep and all that even he could possibly eat, Ishi began to take an interest in his new surroundings. This interest was reciprocated in the local press with several startling repercussions.

Ishi became embroiled in the long-standing animosity between Oroville and Chico over the proper location of the county seat. The Chico papers stood all the Oroville "wild man" stories they could take and then retaliated.

The Chico *Record* observed dry-

ly that many nature fakers had obtained free meals and fine cigars through the gullibility of newspaper reporters with space to fill. The Chico *Enterprise* ran an exclusive story stating that Ishi was a true Indian: A half-breed of different tribal extraction had slipped Ishi the grip of the Ancient and Honorable Order of Redmen, and Ishi had come through in style.

Then the story got on the press association wires, and the St. Louis, Missouri, *Republic* editorialized in these words:

"Here is available material for a stand-pat Presidential candidate. Here is a man without bias towards the direct primary, whose record is like virgin snow and who has never thought about anything. This last is a

qualification of great value. What more could Uncle Joe [Cannon] ask?"

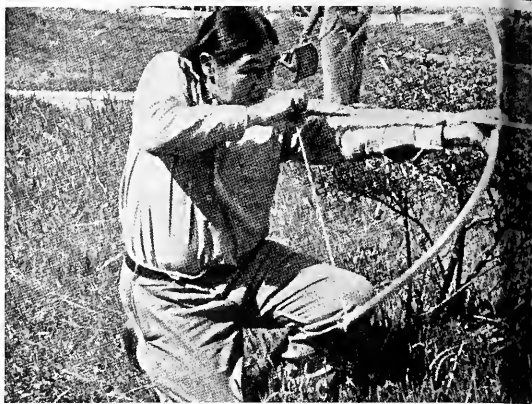
Besides this favorable publicity, the wire service story brought Ishi the happiest years of his life and took the Oroville authorities off the unpleasant hook of wondering what to do with him.

All efforts to dispose of their "wild man" to the Bureau of Indian Affairs, to the State or Federal authorities, had been unavailing, and when Dr. T. T. Waterman showed up with a request that the "wild man" be entrusted to the custody of the University of California, he was welcomed with open arms.

Dr. Waterman had read the wire service story about the "wild man" in the San Francisco papers, put



SAXTON POPE's close study of Ishi's archery provides one of our best estimates of an unspoiled Indian's skill



In fiction, the Indian is described as a matchless archer. True, Ishi was always the first to sight game,

on his hat, compiled a vocabulary of California Indian words, and caught the first train for Oroville. Dr. Waterman was playing a hunch that this might be the last of the Yahi, and if so, the man was certain to be in a completely primitive state, unspoiled by adoption of, or adaptation to, the white man's culture. Several of the artifacts souvenired from Deer Creek were brought over and positively identified by Ishi as his own. Then Bob Anderson came over from Chico and, from Ishi's facial expression and distinctive head shape, identified the captive as the little boy he had saved from death so many years before.

All these helped, but Waterman got his final confirmation when he was at the end of his vocabulary of Indian words. Ishi had shown no signs of recognition as Waterman worked down the list, until they came to the only word that Waterman had in Yana dialect, a linguistic cousin to Yahi. The word was *šūvin-i*, meaning yellow pine. When Ishi heard it, his face lighted up with pleasure, and he repeated it in his own dialect time and time again. It was the first recognizable human sound he had heard since his sister had died and left him to wander the foothills alone.

The rest of the story is quickly told. As Dr. Waterman and his

ward stood on the station platform in Oroville and watched the Western Pacific Limited thunder out of Feather River Canyon and grind slowly to a stop before them, Ishi almost vomited with fright. He had seen trains before but from a great distance, and to him they were monsters chasing their prey across the valley. He had always concealed himself until they passed out of his sight. He would have bolted for the foothills except for the reassuring presence of Dr. Waterman, the man who knew the Yahi word for yellow pine.

The University put him on the payroll as an Assistant Janitor, and he was self-supporting until the day he died. The name of Ishi, meaning Man, was given him by Waterman after they had reached the stage of intelligible conversation together. His real name could only be spoken by another member of his tribe, never by the bearer himself; so as Ishi he is known to history, and the name is more apt than many bestowed at christenings.

The tall buildings that now surrounded him left Ishi unmoved. They were not nearly so tall as the majestic peaks and crags of his homeland. He was taken to watch Harry Fowler start his transcontinental aerial airplane flight, and when the animated bird cage circled above

the throng and Waterman told Ishi there was a white man in it, Ishi only smiled faintly. Automobiles did not impress him half so much as trolley cars, because trolley cars had a gong to clang and something that went *whoosh* when they started and blew dirt off the tracks. If Ishi could return to San Francisco today, he would doubtless recognize many old friends still running down Market Street.

To Ishi, the most wonderful of all the white man's ways were the things we take most for granted—making fire by striking a match, getting water simply by turning a knob, and hiding the light with a window shade that disappeared and came again whenever needed. He relished his dry sleeping quarters and reveled in unlimited food from the University cafeteria. But he used tobacco only to humor those friends who gave it to him, and when it came to alcohol, he summed it up succinctly: "Whiskey-tee crazy auna-tee die man."

These were in truth the happiest years of his life—plenty of food, clothing, and shelter; friends who were genuinely fond of him for himself; and enough work to keep his hands occupied and his heart strong. He made arrowheads, the best ones coming from Bromo-Seltzer bottles, and other handiwork which he gave away with a



and he showed great proficiency in shooting small animals. But men who had practiced the English style

only a few months could out-target him. Archery was really brought to perfection only after the bow was passé

generous hand. Small boys were instinctively attracted to him, and his working command of English was learned from them with astonishing results, as when he replied to a kindly lady's query as to whether or not he believed in Jesus by saying, "Sure Mike."

Although he steadfastly refused to discuss his own family or those last three years of slow starvation, Ishi was always willing to talk about his people. What we know of the Yahi, their customs, legends, music, and tribal history came largely from Ishi, who filled in the gaps of the mosaic.

Ishi believed that "too much *wowi* (houses)" made so many white men sick. He believed that playing with dogs caused paralysis and that tonsillitis should be cured by rubbing the neck with honey and blowing ashes down the throat through a hollow tube or quill. Dr. Saxton Pope, famous physician and archer extraordinary, treated Ishi when he was sick and received implicit obedience and confidence. Pope, you see, was adept at sleight-of-hand tricks, and these Ishi knew and remembered from his boyhood. Had not the Yahi medicine men cured disease by plucking bits of stone or thorn, sticks, and pieces of down from the body of the afflicted?

It was Dr. Pope who finally prevailed on Ishi to accompany him

on a camping trip back to Deer Creek Canyon in the summer of 1914, after reassuring Ishi that they would bring him back to the University. Even after Pope's reassurances, Ishi had three objections:

- a) No houses in Deer Creek
- b) No beds, tables, or chairs in Deer Creek
- c) Not enough to eat in Deer Creek

However, they had a good trip, and Pope comments dryly, in his account of it, that Ishi was the only member of the party to bathe every morning in the icy waters and was the best dishwasher in camp.

All in all, Ishi adapted himself remarkably to the circumstances that surrounded him, and when he died of tuberculosis in 1916, he went as he had lived—without complaint, not railing against the end, with the native dignity he possessed in such great measure.

Dr. Pope and Professor Waterman buried Ishi after his tribal custom. With him in his coffin they placed his bow and quiver, some acorn meal, his fire sticks, some dried venison, and ten pieces of dentalia (Yahi money), to see him into the afterworld. After cremation his ashes were placed in an earthenware jar of Indian manufacture, and on the outside of the jar was inscribed this legend:

"Ishi, the last Yahi Indian, died March 25, 1916."

Now, Niche 601, Room B, in Olivet Columbarium near San Francisco, is Ishi's homeland forever, but his spirit must live on so long as these words of Professor Waterman remain:

"He convinced me that there is a gentlemanliness which lies outside of all training and is an expression purely of an inward spirit. It has nothing to do with artificially acquired tricks of behavior. Ishi . . . had an innate regard for the other fellow's existence and an inborn consideration that surpassed in fineness most of the civilized breeding with which I am familiar."

As I look up at the broken arrowhead and the crude stone ax, I wonder if they were not Ishi's, and if they were, whether he would approve my ownership.

*Ishi*

Ishi's signature

For further information concerning Ishi, the reader is referred to T. T. Waterman's excellent paper in Univ. of California Publications in American Archaeology and Ethnology, vol. 13, No. 2 (1918) and to special articles by other authors in the same volume.



# Wiles of the Water Witch

Now you see it, now you don't. The Pied-billed Grebe's habit of drawing a "blanket" over its nest makes it an interesting study in bird behavior

By LEWIS WAYNE WALKER

*Photographs by the author*

PERHAPS you know these birds by some purely local name. It might be "dabler," "dabchick," "diver," "dipper," "hell-diver," or a host of others, including the one used in the title. And as the breeding range of these birds not only covers most of the United States but also stretches south to Argentina, I shudder to think of all the other cognomens by which they are known—those of Portuguese or Spanish derivation. However, most of these localized names describe some definite trait, either descriptive or illusive, and many of them will probably not soon be supplanted by the textbook term, Pied-billed Grebe.

In many ways these birds are really tulle or cattail witches, for they are so at home in marshy waters that they can remain close to an intruder without being seen. Sometimes they dive to the depths by springing above the surface and arching into a beak-first pose. But when they desire to be secretive, they can just slowly submerge like a piece of waterlogged wood without leaving a ripple to mark the

spot. They may reappear a hundred feet away and announce their location by an explosive bob to the surface, or they may come up in the midst of a raft of floating reeds within arm's length, with only beak and eyes above water level.

This trick of watching an enemy while remaining practically submerged is just one of the many ruses used by grebes in their struggle for survival. A few of these ruses follow patterns well known in the bird world, such as feigning injury with the possible result of leading an enemy away from eggs or young.\* One of their tricks, however, the covering of the nest during absence, seems almost wholly confined to grebes.

Most marsh areas overgrown with cattails or tules have numerous rafts of rotting vegetation lodged on the surface of the water and held in place by growing stalks.

\* Another interpretation of this behavior is that the presence of a possible enemy creates an emotional conflict between an innate urge to flee and one to stay on guard, producing the disturbed behavior referred to. Animal psychologists generally do not consider it safe to assume that the bird feigns injury deliberately to fool an observer.

In fact, they are so common that most observers rarely give them a second thought and pass them by without investigation. Yet one of these seemingly waterlogged piles of rubbish may be the nest of a pair of pied-billed grebes, built in a haphazard way and resembling the debris of the area.

However, white eggs are easily seen no matter how well their cradle is camouflaged. As though to compensate for the fact that their eggs are not endowed with protective coloration, the grebes adroitly execute their slickest trick. At the slightest sign of danger, an incubating parent makes two motions almost simultaneously: the body is pushed sideways toward the edge of the nest, while the beak reaches across the eggs and grasps a tangled mass of rotting vegetation. As the bird submerges, this dripping blanket is drawn over the eggs and then dropped, completely hiding them from sight. One does not know, of course, what is going on in the grebe's mind or how much of its behavior is more or less automatic and unreasoned.

A SEEMINGLY WATERLOGGED pile of rubbish may be the nest of a pair of pied-billed grebes. It is built in a haphazard way and resembles the debris of the area

The covering of the eggs may have survival value as a protection from direct sun or by providing some measure of heat from the rotting blanket of vegetation. Or it may, of course, help the birds in their struggle for survival by offering concealment from enemies.

The grebes' return to the nest is also shrouded in an aura of deception, for during the nesting season their behavior shows every indication of distrust. The attitude of the family can best be described by the old saying, "Even the walls have ears."

Perhaps the first clue to the parents' return will be a series of cackling calls from the midst of the aquatic growth—calls that change place and direction so rapidly that the birds almost seem to possess ventriloquistic powers. The next sign may be delayed for ten or twenty minutes. Then a bird may come bobbing to the surface in the center of a clear patch of water, perhaps right at the feet of a waiting observer. It might spend the next few minutes paddling around

in plain sight, pecking at inconsequential objects floating by. If this fails to arouse the onlooker's interest, the bird's tactics change again, and sometimes it will aquaplane along the surface as though endeavoring to induce a chase. In this display it holds its body in a vertical position and skids on its tail, propelled by both feet and wings.

If a chase still fails to materialize, almost anything can happen, for no two pairs indulge in the same routine. Sometimes one bird plays the dominant role while the other stealthily approaches the nest. One family that I watched for several days appeared intent on convincing me that a near-by coot's nest was their home—much to the chagrin of the coots.

As a general rule, these noisy and visible shows are of short duration and are followed by a period when the area seems deserted. Then, if the nest is watched closely, a serpentine head may be seen to poke above the surface of the water. The bird's body will gradually follow but so slowly that hardly a ripple radiates from the spot. As the witch slides on the nest, her beak grasps one edge of the covering and folds it to one side, just as we might fold a blanket. After the eggs are

adjusted under the feathers, the blanket is arranged just so, ready for instant use when needed.

On one occasion, I chanced upon a nest within a few minutes after the hatching of the first few eggs. At departure the parent had hidden the chicks under the soggy covering, but the movements of the young pushed the blanket aside and exposed them. From that moment, deceptive behavior was abandoned, and the parents resorted to outright attack. Both adults made headlong charges that brought them within two feet of me before they arched their bodies to disappear into the water.

The striped young were precocious and within minutes after emerging from the eggs roamed all over the nest. But unlike the chicks of most birds, these progressed "on all fours," somewhat after the fashion that the earliest prehistoric birds may have done when they were emerging from their four-footed reptilian ancestry. Their progress through the water also differed from that of our better known aquatic birds. These young swam toward their frantic parents just as they had crawled, on all fours, with beak and wings awash and only the head held high.

► CONCEALED beneath its blanket of rotting vegetation, the grebe's nest may be almost undiscoverable



▲ THE WHITE EGGS are quite conspicuous when the covering is removed during the parents' absence



► A JUST-HATCHED GREBE among the remaining eggs





# Borgia of the Insect World

The cannibalistic female mantis  
is one of nature's most ex-  
traordinary assassins

By

EDITH FARRINGTON JOHNSTON\*

Drawings by the author, from *Strange Visitor*,  
published by the Macmillan Company

▲ TROPICAL MANTISES are said to devour small toads, but not the Chinese mantis that is common in eastern United States

"WHAT is that horrible-looking creature?"

This is a question I am asked many times every year between August and November.

The horrible-looking creature is the praying mantis. Even before she goes into action, the female mantis, with her great size, large dull eyes, long angular legs, and spiked and serrated arms, may well stop the beholder in his tracks.

During her early life, from May to August, she is so slender and so much like the green vegetation which she inhabits that she is almost never seen. East Indian natives believe that she starts as a small shoot on a plant and first

achieves a life of her own in autumn, when she is full-grown. But once her life history is understood, it is fairly easy to find her by searching in the right sort of spot, even in early summer.

In the United States several species of mantises† are common. However, the one most frequently noted and collected is the Chinese form, *Paratenodera sinensis*. Its egg masses were accidentally introduced into the United States on nursery

†When speaking of more than one praying mantis you can say mantises, mantes, or mantids. All mantises belong to the family Mantidae, and for this reason scientists generally prefer to call them mantids rather than mantises. The word *Mantis* designates a particular genus of mantids. *Mantis religiosa*, for example, is the common European form. However, popular usage has favored "mantis" and "mantises" as general terms.—Ed.

stock from the Orient in 1896. Since then it has become thoroughly naturalized and has increased and multiplied. It is one of the most useful of insects, devouring vast numbers of grasshoppers, crickets, cicadas, wasps, and even large spiny or hairy caterpillars. It has gained such a reputation as a benefactor of gardens that in some localities enterprising small boys have collected considerable numbers of the egg masses to sell to amateur gardeners.

The insect catches the attention of the layman not only because of its size, peculiar structure, and its custom of perching on penthouse porches, railway station ramps, or

\* EDITH FARRINGTON JOHNSTON is best known to nature-lovers for her paintings of flowers. The originals have been shown from New York to California, and reproductions in current magazines have established their popularity with the general public. Her three books, done in collaboration with Margaret McKenny—

*A Book of Wildflowers*, *A Book of Garden Flowers*, and *A Book of Wayside Fruits*—have become classics for young people's libraries. In these three books Mrs. Johnston did the color-separations for the lithography herself.

Her recent book *Strange Visitor*, a child's story of the life of the praying

mantis, is gaining wide acclaim as the only popular-type book on the subject. Mrs. Johnston spent leisure time for ten summers studying and sketching mantises, for firsthand information. At present Mrs. Johnston is working on a book of 30 common Lepidoptera, with text and pictures from personal observation.—Ed.



city fire hydrants but also because it is often noticeably colored. Entomologists tell us that, just as dark or drab-colored creatures sometimes exhibit albino forms, green or greenish insects often produce individuals of varying degrees of pinkness. Sometimes this variation takes the form of a mere shadowing of brown on legs and wings, the chromatic result of spreading pink over green. Frequently the pink has almost superseded the green on abdomen, underwings, and thighs, leaving them a true pink but qualified by the residual green to a shade known to fashion-writers as "dusty pink." And occasionally nature discards all prudence and releases to a hungry world a veritable rose-colored katydid or grasshopper or mantis, doomed, one would think, to an early death by its contrast with its green habitat. Oddly enough, many Chinese mantises with pink abdomen and underwings are captured every year—after they have survived to full maturity! Their escape from enemies can probably be explained by the fact that, except in moments of agitation, the gauzy pink underwings are folded out of sight under the leaf-brown wing covers with their birch-green edges, and the rosy abdomen is visible only from below.

The female particularly has gained the reputation of being fierce and carnivorous, but you need not believe stories that the male contents himself with vegetable food alone, for he is just as carnivorous as the female. I have raised many young mantises straight from the egg case, feeding them on fruit flies; and if the males were truly vegetarians, they would show a Hitlerian distaste for this meat diet. I have never seen any of them discriminate against it. At the same time, if you want any males to grow up, you must isolate them at a very tender age, else they will fall victim to the cannibalistic tendencies of the females.

The female, as she matures, and particularly when she is heavy with eggs, develops a feral voracity and an ability to satisfy it, which make her a menace to all insect life. The

curious thing is that insects never seem to fear her or to make any effort to escape her advances. The katydid, the butterfly, the masked grasshopper, and the cricket all seem to accept her as a fellow insect and to have no suspicion of her evil designs upon them.

On a grassy bank one late autumn day I saw an endless tapestry of insects, interwoven with brambles, belated butter-n-eggs, faded grasses, dwarfish goldenrod, asters, and red clover. The theme of the weaving was the hunt of the mantises for their prey, its capture and ingestion. But here was no swift action, no wild panic and pursuit. Like actors in a slow-motion film, the prey crept gently among the slanted weeds, too little warmed by the waning sun to run or leap, while the carnivorous

huntresses, whose meat diet better fortified them against the encroaching chill, stalked and consumed them without haste or animosity.

Among her own kind, the female is not at all deterred by ties of kinship from eating her own siblings. Even at mating time, when a certain tenderness might be expected to prevail, she will turn her mournful head backward, bite off her husband's head, and absent-mindedly start munching along down his thorax while he is in the very act of giving life to her 300 eggs!

The female mantis usually appears to be without fear. She is ready to do battle with any foe, from insect to man. Her fixed hypnotic gaze, as she slowly turns her head, follows your every movement. She is one of the few insects



▲ SHE held up her bent arm in front of her mouth, moistened her wrist, and washed her face just like a kitten



◀ MADAME MANTIS reared back like a horse when the katydid came jauntily along the leaves. Then—snick!—and her arms darted down like a bear trap

able to turn its head, an ability which contributes much to her uncannily knowing look. The two great, dull-colored eyes seem to have no pupils, but down in their depths a small dark dot is dimly visible. Between them, in the forehead, are three well-developed ocelli; one wonders what she perceives with them and if they are functional eyes at all.

Few insects give so much evidence of possessing some power of thought. True, the ant lion automatically casts up his spray of sand to engulf the hapless ant dashing frantically around the walls of his funnel, and the spider at the center of her web rushes forth at the right moment to dispatch her entangled victim. These are simple responses to obvious stimuli. But put a large, lively spider into the

jar with your mantis. The spider has been disturbed by your handling and runs around and around, sometimes passing close to the mantis but always going too fast for even her catlike pounce. At first she rears as if to grab it—her normal response to the sight of an insect in motion—but then she makes no further move. She only waits, as though contemptuously, until the spider has settled down to catch its breath. Then, with infinite stealth and deliberation, she sets herself in a favorable position—and snick!—quicker than the eye can follow, she snaps her trap on it.

And one can scarcely deny that she employs a measure of discrimination when she has captured a great digger wasp gliding to the ground with a fat cicada to place in its burrow. There in her trap

the mantis has both the furious wasp and the cicada, paralyzed by the wasp's sting. She considers her catch, turning her head this way and that. Then she grasps the wasp firmly and proceeds to eat it, letting the doped cicada drop to the ground, where she will retrieve it once the wasp is consumed. She shows no hesitation, no uncertainty. To all appearances, she deliberates and reaches the right conclusion. But who can say where instinctive behavior ends and thought begins?

Then there is her reaction to toads. Books tell us that some tropical mantises devour small toads and even small birds. The Chinese mantis in the eastern United States does not eat toads, but her reaction to them is interesting. The Brooklyn Entomological Society records that once an experimenter offered a very small toad to a very hungry mantis. She seized it but dropped it immediately, and nothing could induce her to touch it again. I had a very large *Paratenodera sinensis* which I kept under a bell jar one summer in New Jersey. I had at the same time a half-grown toad which I sometimes introduced under the jar when I had time to watch and remain ready to effect a rescue if necessary. At least once each evening, and often two or three times, the mantis would, after long deliberation, swoop down in front of the toad and rear up, with underwings fully displayed, in what Fabre calls her "spectral" attitude. But having gone that far, her appetite for toad seemed to fail, and she never actually touched him. Possibly the toad's nervous reaction to the shock of her swoop elicited some mantis-repellant effluvium imperceptible to our gross sense. At any rate, she always checked herself on the very point of grabbing him. In the course of the summer the toad became quite blasé about it all, and although unable to keep from wincing a trifle, he would then

sit motionless with drooped lids and a look of "Oh yeah?" on his toadish features. It is impossible to know whether the mantis uses some obscure reasoning power or whether she is controlled entirely by instinct.

But whether motivated by instinct or by the rudiments of reason, the behavior of the full-grown female mantis shows more variation and originality than is observable in the behavior of many other insects. Each mantis has her own marked individuality. Some are nervous and high-strung, quick to strike at any sudden motion. Some are so deliberate that it is hard to believe that they do not exercise judgment and weigh a choice of courses. Some make most interesting pets, because they will drink milk or water from a small dish or teaspoon, take bits of raw meat



▼ MADAME MANTIS was clasping another mantis in her spiny arms—a sister, so it seemed. There wasn't much left except its horny legs and gauzy wings

▲ AN AIR of fastidious calm lent greater horror to her murderous actions



from the fingers, or sit companionably on the worktable, staring curiously at fingers or pen as you write, quite as if they were trying to comprehend. Others are always "stand-offish"; they will have none of you or your offerings and will starve to death rather than try an unaccustomed food. Some, having seized a prey, seem to know that a bite in the cervical ganglion will end the victim's struggles, and they put this knowledge to good use; but others, no less powerful and active, never acquire this precision of technique but catch the prey as they can and hold fast with the serrated arm, so that the captive continues his struggles until he is almost consumed. Some make a practice of biting off the head first. Others always start the meal by pulling off a leg and holding it up in a gloating manner, gazing at it with the head turning this way and that before eating it, while



▲ THE ANGULAR GAIT of the mantis reminds one of a slow-motion film, until prey can be captured. Then, a catlike pounce. But remember, the mantis is entirely beneficial to man

some sybaritic mantises will accept neither legs nor wings, thorax nor head, but plunge the triangular beak into the abdomen and lick out all the soft inner parts. These fussy females often leave the victim's outer parts almost intact, so that only by turning the body on its back can you see that nothing is left but a hollow shell, complete with legs and wings. This type is the hardest to provide for. Apparently the abdominal contents are less sustaining than the more muscular portions, and so the insect gourmet drains grasshoppers, crickets, cicadas, and so forth so rapidly that it takes much hunting to provision her larder.

The differences in behavior are paralleled by differences in the

externals of nest-building. No two "nests," or egg cases, are exactly alike. This variation results not from whimsy but largely from sheer chance. The shape and size of the twig chosen to support the egg case, interruptions during the long business of nest-making and egg-laying, and possibly even the presence or absence of a breeze at the crucial time may serve to cause slight irregularities in the outer shape of the nest. Certain nests are as fancifully draped and swathed as a Moslem's turban; others are so nearly flat on top and bottom and so short as to make you

► MANTISES even devour large spiny or hairy caterpillars

think that a pat on each of four sides would reshape them into cubes. Occasionally a very small egg case occurs among large ones; it is made by a female that has already produced one or even two larger nests with their complement of eggs.

During its creation and for a very short time thereafter, the nest is almost pure white, very light, and frothy; but it starts to harden and darken in a few moments and stands all winter as an inconspicuous, dirty, sand-colored lump, hard to notice among the weeds and twigs. The mantises seem to regard certain trees and shrubs as especially well-suited to nest-building. Sometimes you may search for hours on a hillside without finding more than one or two nests and then suddenly discover a sapling bearing as many as 30 cases. Is it favorable location that determines the choice, or is it some quality of sturdiness or durability in the chosen twig?

Much remains to be learned about the mantis. Her increasing numbers and the fascination of observing her ways should tempt someone, perhaps now a mere Cub Scout learning first lessons in woodcraft, to make a full-time study of this one insect that is entirely beneficial to man.



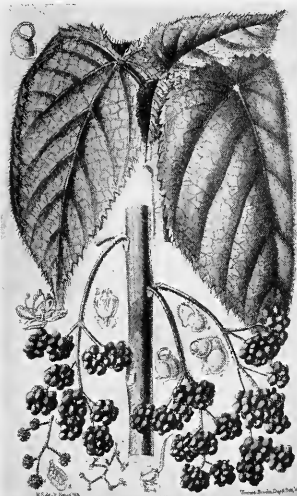


Photo courtesy New York Botanical Gardens

▲ CONTACT with a single hair on the leaf can cause severe pain to spread throughout a large portion of the body. *Laportea moroides*

tree, called the shining-leaved stinging tree, *Laportea photiniphylla*, grows to a height of about 60 feet. Its leaves are less nearly heart-shaped. It is found from Brisbane to Rockhampton and may be somewhat scarcer than the first. I never saw one.

## SOS FOR AFRICAN WILDLIFE

Continued from page 111

agriculture and husbandry and the consequent slaughter of the game, there have been attempts to set aside parks for the wildlife. South Africa's Kruger National Park, where game is now suffering from overstocking and a severe drought, is of course the most famous. Umfolozi Reserve has already been mentioned, and in Natal there is a second refuge called the Hluhluwe Reserve. Southern Rhodesia maintains a reserve of sorts at Wankie, way over in the western corner of the country. But in the once faunal-rich regions of British East Africa, parks are at a premium.

Perhaps best known is the 40-square-mile park within four miles of Nairobi, where even the casual tourist can motor out from town in about 20 minutes and see pic-

The third species, more a shrub than a tree, possesses most virulent stinging hairs. Moreover, it is the more dangerous from the fact that it grows up along abandoned lumber tracks, reaching over the track from the side so that it is most difficult to avoid. This is *Laportea moroides*, or the "mulberry-like" *Laportea*, which derives its name from the reddish-purple fruits. Its leaves vary from three to eight inches in length. This venomous plant was very common in the tropical rain forests of northern Queensland. When we planned to use the old trails for hunting or for setting trap lines, our habit was first to go through them with bush knives and cut away every single stinging shrub, large or small. Even that operation required care and vigilance, as the cut stems were likely to fall upon the hand holding the knife, with dire results.

Like many other countries, Australia possesses a quota of additional harmful plants, including some deadly ones, sometimes accidentally eaten by stock. Aside from such inedible vegetation, I know of none so intensely objectionable as the stinging trees.

turesque African animals. The park contains a wide variety of animals, including at least a score of big game species. The large Northern and Southern Game Reserves in Kenya have been in existence for a number of years and are very important, but at present there are no national parks in Kenya, in the true sense of the word.

In Tanganyika the famous 908 square-mile Serengeti Reserve was set up in what Caldwell calls "the greatest faunal area in the world," but thus far it is a park in name only. Tanganyika also has the Selous Reserve and various other game reserves, but they are not adequately administered. Northern Rhodesia has vague plans to someday create a national park and is far and away the most enlightened

of the British colonies in the matter of game protection, management, control, and perpetuation. Uganda has no national park and no plans for one. The Congo, of course, has some very famous parks and reserves.

There are several organizations concerned with protection of African wildlife, among them the Wild Life Protection Society of South Africa and the Society for the Preservation of the Fauna of the Empire at London, but they are neither financed nor officered and manned for the battle they must fight. In this country, the American Committee for International Wild Life Protection is doing what it can in the problem and has published a number of bulletins.\*

I cannot see the problem as a purely British one. Destruction of the unique and magnificent life of Africa would be a global tragedy, and like so many other world problems, it needs a global solution. Obviously, the tsetse fly must be destroyed or men and animals must be made immune to the diseases it carries. It is also obvious that the wild animals in much of Africa stand in the way of settlement of the country. Both problems must be faced. One way to solve them is to continue planned game extermination. Another is to leave the game to the unplanned fate of the American bison.

Vilhjalmur Stefansson might suggest that, since Africa abounds with animals that have already solved the problem of the tsetse by acquiring immunity to nagana, new animals should be selected from among them and domesticated, rather than to warp Africa's ecology to fit alien animals from other lands. But aside from this untried solution, it seems to me that two things should be done:

(1) More extensive parks and game reserves should be established, and, even more important, funds should be made available for the adequate staffing and patrolling of these reserves so that they may

\* Readers wishing to obtain further information concerning organizations working for conservation in Africa may address their inquiry to Richard Pough, Curator of Conservation and Use of Natural Resources, the American Museum of Natural History.—Ed.

become the refugees they are intended to be. Native hunting should be more closely controlled and efforts should be made to cut down the tremendous toll in fatally wounded animals that the hunter cannot, or does not, retrieve. If for no other reason, game should be perpetuated as an invaluable source of meat for people living on little else. Professional hunters and sportsmen should be closely controlled by game experts.

(2) Far more funds and scientists should be made available for research on tsetse fly, the diseases it carries, methods of eradication of the insect, and possible immunization of animals and men against nagana and sleeping sickness.

That will be a costly and perhaps a prolonged program. But game extermination would also be a prolonged and costly process. The diseases carried by the tsetse have

plagued Africa since the dawn of time, and their cost in suffering and in retarding the economic development of the country have been incalculable. Whatever must now be spent, whether it be spent by Britain, contributed by private parties, or allotted by UNESCO or some other international organization, it would represent for future generations a cultural benefit and an economic saving beyond imagination.

## BOOKS

Continued from page 103

who has thrilled at the sights and sounds and odors in the outdoor world.

JOHN R. SAUNDERS.

### ANT HILL ODYSSEY

----- by William M. Mann

Boston: Atlantic-Little Brown, \$3.50

AMONG the most difficult problems one can have is to review a book by someone whose company he has enjoyed over a long period of time. One has the feeling that he might discover that the author does not write as well as he talks. Bill Mann has demonstrated in this autobiography of the early part of his life that any such fears are wholly ungrounded. He writes about interesting subjects with such keen understanding that one lives with him and meets the people about whom he is writing.

In this book we grow up with a naturalist and travel with him to various parts of the world. We enjoy all the excitement accompanying the many discoveries of a great scientist in the making: the boyhood ambitions and indiscretions, the thrill of finding things not known to science, the almost reverent feeling that Mann had because he was able to work with men who had won greatness in the field of science. Bill Mann professes to be an entomologist, but he has always been more than that. To be sure, his chief interest has been insects, and particularly ants, but his great love of all animals has had a happy influence on his whole life, as one gathers in *Ant Hill Odyssey*.

Bill differed from most kids—he not only wanted to run away from home; he did it. This early adventure was a tame prelude to what was to follow in later years, when he wandered over the face of the earth on various missions of discovery. A most interesting feature of the

book is that it covers only that part of his life when the author was obtaining his academic education. The story ends when William M. Mann obtains his first regular job with the Bureau of Entomology, at what he calls the incredible salary of \$1800 a year. We hope that a later volume will tell of his later explorations and record the events leading to his appointment as Director of the National Zoo.

C. H. CURRAN.

### Do Not Miss

#### The Man Who Stole a Shooting Star

The story of the famous Willamette Meteorite, which many readers have seen in the Hayden Planetarium: an absorbing article by Paul M. Sears soon to appear in *NATURAL HISTORY*.

### THE FLIGHT OF BIRDS

----- by John H. Storer

Cranbrook Inst. of Science, Bloomfield Hills, Mich., \$2.50

94 pp., 176 ill.

JOHN H. STORER is well known for his superb slow-motion films of flying birds. With the assistance of foremost experts in the fields of aircraft design,

gliding, and ornithology, he now has written this important and thorough analysis of bird flight. The principles of aerodynamics are first explained briefly with the aid of drawings and photographs based largely upon wind tunnel experiments. The structure of the feather and of the bird's wing are next described. In the airplane the lifting wing and the propeller are separate entities, whereas in the bird, lifting surfaces are provided by the tail and by the inner part of the wings, while the outer or hand portion of the wings furnishes most of the propulsion. When soaring, however, a bird may rely upon air currents for propulsion and use its entire wing surfaces for lifting. At the other extreme, the wings of a hummingbird function almost entirely as propellers, attached to the body by swivel-like joints at the shoulders.

Guided by these basic principles, various phases and types of bird flight are interpreted with the aid of carefully selected sequences from the author's films. When necessary, F. L. Jaques has provided sketches to depict more clearly the position of the flight feathers. Most readers will acquire a new understanding of bird flight from this book and at the same time be made aware of unsolved problems such as the difference in the design of the wing in soaring birds of the ocean and of the land. It thus should achieve the dual goal of providing sound information about the flight of birds and of stimulating further observation and research.

DEAN AMADON.

### Winners of the Wild Mammal Cryptomaze

in the January issue of *NATURAL HISTORY*: The three contestants submitting the highest number of mammals listed in the main section (A-Z) of *Webster's New International Dictionary—1943* (unabridged), in accordance with the rules of the contest, are: DR. HENRY S. RICH, Bronx, N. Y.—32 mammals; PETER F. BELLINGER, New Haven, Conn.—31 mammals; RICHARD G. BEIDLEMAN, Fort Collins, Colo.—31 mammals. Each of these winners has received a copy of *Wild Animals of the World*, illustrated by Mary Baker and written by William Bridges, published by Garden City Publishing Company.

Mammals both above and below the line in the main section (A-Z) were counted, but variant spellings of the same name and words from other sources were not. It is not in the rules of the contest to jump up and down on the same square to form a double letter. Where any of the aforementioned irregularities occurred, the contestant was not disqualified, but he was not given credit for the mammal.

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# CRYPTOMAZE

SEED PLANTS *By* EDWARD DEMBITZ

**Part 1.** In this puzzle you are given a set of definitions, each with a set of blank spaces, and a diagram to be filled in. Each definition is a clue to a word whose letters you are to insert in the blank spaces preceding the definition. These words appear in recent issues of NATURAL HISTORY Magazine.

—	—	—	—	—	—	—	Southwestern Indians whose language was
20	9	18	9	1	15	3	used as a code in World War II

— 12 — 8 — 13 — 19 — 20 — 11 — 2 — 15 — 20 *American painter (1861-1909), best-known for Western scenes and drawings of horses*

— — — — — *Lighted on Christmas Eve, it once served*  
16 7 14 22 14 15 11 *in heathen sunshine-making festivals (2*  
*words)*

—	—	—	—	—	—	—	—	—	Long-billed shore bird whose wing vibration while diving produces a "song"
1	17	4	5	3	20	19	23	8	

—	—	—	—	—	—	—	—	Large South African desert, home of the Bushmen
5	9	14	9	6	17	12	19	

— — — — — Asiatic plant whose fibers were used by  
12 17 13 19 25 the Egyptians in wrapping mummies

— — — — — *Biological station in Florida, named for*  
17 12 4 6 10 15 14 24 *an American Museum Research Associate*

22	7	4	9	14	16	23	2	19	Common Australian trees whose leaves form the exclusive diet of the koala
----	---	---	---	----	----	----	---	----	---

—	—	—	—	—	—	—	—	Plant that traps pollen-bearing insects in its flowers
13	19	14	5	21	22	22	24	

— — — — — Spider that spins a circular web of  
15 12 10 21 22 17 18 25 12 radiating and spiral threads (2 words)

**Part II.** When you have filled in all the letters above, transfer them to the proper numbers in the boxes in the diagram below.

When the diagram is completed, you will have a word maze containing at least 36 names of SEED PLANTS (flowers, trees, shrubs, vegetables, herbs, etc.). To find one of these plants, begin with a letter and move from space to adjoining space in any direction, including diagonally, until the name is spelled out. You are not permitted to form double letters by jumping up and down on the same square.

Copyright 1949  
By Edward Dembitz

**THREE PRIZES.** The three contestants submitting the largest number of names of plants fitting this puzzle will each receive a copy of *THE WILD FLOWER GUIDE*, by Edgar T. Wherry, recently published by Doubleday and Company.

Names of plants must appear in bold-faced type in the main A-Z section of Webster's New International Dictionary—1948 (unabridged) in order to be eligible. Names in bold-faced type below the line at the bottom of the page are allowable. Different names for the same flower, tree, shrub, vegetable, or herb will be accepted. But scientific or technical names will not be counted unless they are in bold-faced type.

*In case of ties, duplicate prizes will be awarded.*

Entries must be postmarked on or before April 1 and be received by April 6, 1949.

Winners and their scores will be published in NATURAL HISTORY for May, 1949.

The contest is open to everyone except employees of the American Museum and of Doubleday and Company, and their families.

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# THE DEVIL'S SLIDE

BY

VERA and HENRY BRADSHAW

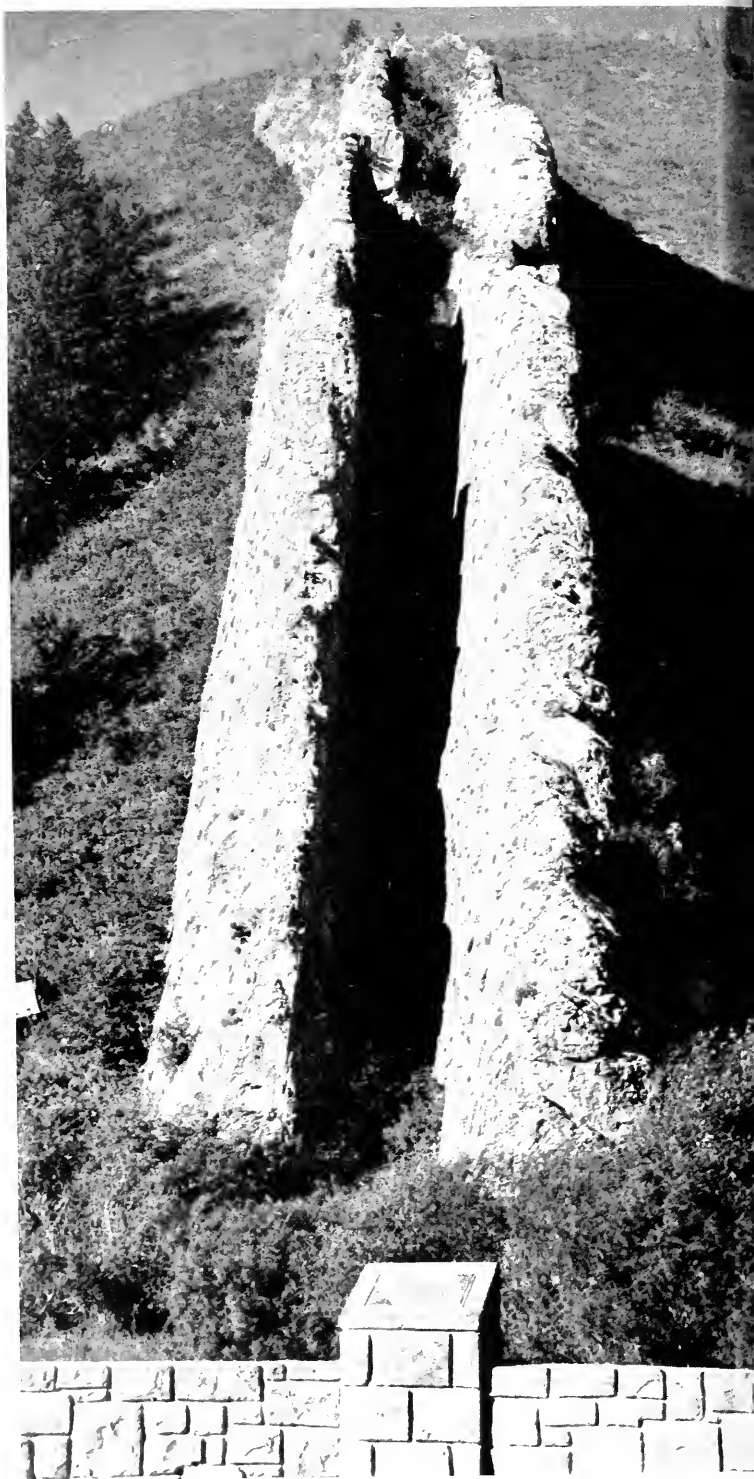
MOTHER Nature, in addition to creating things of great beauty, has produced a number of freaks. One of these outlandish, awe-inspiring displays is "Devil's Slide" in historic Weber Canyon, Utah.

It is two gigantic horizontal pieces of rock extending down a steep hillside, and so closely does it resemble a chute-the-chutes that, at first, one wonders if it were not built by human hands. Geologists say no, that the queer formation came about in a prehistoric age and happened something like this:

The rock layers had been created in the earth over a hundred million years when along came a violent compressive force which folded and upheaved them.

Many years after this, the simulated slide was formed because a layer of shale, tucked between the two more durable limestone layers, eventually wore away and disappeared. Thus, the two protruding sturdy limestone sides were left to form the famous "Devil's Slide."

► A STRANGE PHYSIOGRAPHIC FORMATION that almost looks as though it had been built by man: the Devil's Slide in Utah





*April*

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# LETTERS

## "Nature's Little Tank" in Florida

SIRS:

Recalling Karl H. Maslow's article on the armadillo in the October, 1948, *NATURAL HISTORY*, I offer the following observations on this animal in Florida.

I have lived in Daytona Beach my entire lifetime (50 years). About the year 1930, for the first time, there appeared on the mainland of our county a few little creatures that, after some study and inquiry, were catalogued as armadillos. It was, and continues to be, a matter of conjecture as to how these little fellows found their way to the eastern shore of Florida, approximately 100 miles south of the mainland of the United States on the Florida peninsula. Your readers will recall that the armadillo's movement northward from Mexico during the past 100 years has not progressed nearly as far eastward as Florida.

For a number of years, these little fellows continued to inhabit the mainland of our county. While it was not a common sight to see them, they nevertheless gradually grew in numbers, and about 1940 they began to appear on the island created by the Halifax River. This island is about 3 miles wide and some 60 miles long. The river, if such it may be called, begins and ends in the Atlantic Ocean and is about a mile in width.

The island, as well as the mainland, is, generally speaking, high and sandy, with a growth of wild palmettos and large numbers of citrus groves and vegetable gardens. The armadillos seem to have thrived and have now reached a population equal to that of the other small animals of our countryside, such as rabbits, squirrels, etc. As an example, when I was taking an early morning trip from Daytona Beach to Ormond, a distance of seven miles on the island referred to, I saw eight armadillos scampering across the highway. They do not yet cause extensive damage, but some of the people engaged in cultivation have been troubled



▲ FLOATING AIRDROME. A camera study by Dr. Lorus J. Milne, heralding the return of warmer summer days

by them and are beginning to voice concern.

This information may be interesting for the record, and possibly you may be able to give further facts concerning the story of the armadillo in Florida.

RAY SELDEN.

Daytona Beach, Fla.

The following comments are offered

by T. Donald Carter of the American Museum's Department of Mammals:

There are records of armadillos in Florida as far back as 1922, when one was taken near Miami. It was then discovered that at the end of the first World War, a Marine had liberated a pair close to where this animal was taken. He had brought the original pair from Texas. Later, about 1924, some armadillos escaped from the Cocoa Zoo in Brevard County. These animals also originally came from Texas. Soon they were becoming quite common in that region.

About ten years ago, a friend of mine reported that an armadillo was spending much of its time under her house in Rockledge. And three years ago, an acquaintance who lives just north of Rockledge told me that the armadillo had become a common animal in that district and had only lately crossed the bridge over to Merritt's Island.

The armadillos around Daytona Beach undoubtedly are descendants of the Cocoa animals which have moved farther north. It is very possible that armadillos have



## "Wonder House,"

### a Film Portraying the American Museum

The attention of readers is called to a new motion picture entitled "Wonder House," which tells the story of the American Museum of Natural History. It is one of the *This Is America* Series, produced by RKO-Pathé News, and will be released soon after April 1. Persons interested in seeing this unusual picture should ask the manager of their local theater when it will be shown.



▲ **BÊTE NOIRE:** a Wolf Spider of the family Lycosidae. Two of its four large eyes are visible, as well as the four smaller ones. Photographed by Henry B. Kane

been introduced elsewhere in eastern Florida without our knowledge. I feel fairly confident that the armadillo did not find its way to the east coast of Florida without human aid, although the eastern movement from Texas seems to continue. The animals have successfully crossed the Mississippi River and have established themselves in both Mississippi and, more lately, in Alabama.

#### **Do Eskimos Rub Noses?**

SMS:

Do Eskimos really show affection by rubbing noses, or is this only an idea that has grown up?

JOHN ROSHEK, JR.

Dubuque, Ia.

Yes, Eskimos do show affection by rubbing noses but not quite in the way that many people have come to believe. Almost always the gesture is used by a parent toward a small child, especially after a long absence, or between children. The custom has been observed widely in the Eskimo region, from St. Lawrence Island in Bering Sea to East Greenland.

A man and a woman do not ordinarily rub noses. However, it was reported some years ago that a bride and groom in East Greenland customarily kissed each other by rubbing noses.

A curious game has been reported among the Eskimos of King William Land, in which the winner goes around a whole row of women, placing his arms around their necks and nuzzling violently at their noses. As the game progresses, the wholesale nose-rubbing may

cause the noses of some of the women to bleed.

From Alaska, we have occasional mention of nose-rubbing as a greeting for strangers in earlier times. In 1826, when the explorer Beechey visited St. Lawrence Island, the Eskimos rubbed their noses against his and further expressed their welcome by rubbing the palms of their hands over his face.

Kissing as we know it seems to have been quite unknown among the Eskimos before the coming of white men.—Ed.

SMS:

... Being especially interested in the study of ancient man, I find the articles you have published on the later discoveries along this line in South Africa very interesting and highly educational. There

seems to be an unlimited field ahead for such work, and many more discoveries may, of course, be made in the next few years. Let us also hope that more interest will be shown here in America in unearthing further evidence of Folsom Man.

I am very grateful to you for these many wonderful items of interest and am looking forward to more articles of this sort in *NATURAL HISTORY*. With best wishes for your future success, I remain

L. B. SIMONS.

Laton, Calif.

#### **Animals in Silver**

An unusual exhibit entitled "Shining Birds and Silver Beasts" will remain on display in the 77th Street Foyer of the American Museum through April 15. The exhibit shows the work of Paul A. Lobel, who has made a specialty of stylized portrayals of animals in sterling silver.

#### **Eclipses in the Planetarium**

Eclipses of the sun and moon have been charged with mystery and wonder since before the dawn of history. Their strange beauty has attracted the attention of people in all ages. While much of the mystery is gone from these phenomena today, they are still of great interest to the astronomer and hold a weird fascination for the layman.

Visitors to the Hayden Planetarium during April will enjoy the splendors of lunar and solar eclipses beneath an unclouded sky. With time condensed and the heavens under complete control, the lecturer will explain many of the strange and interesting facts associated with celestial blackouts. He will be aided by the use of a special eclipse projector, which will clearly demonstrate the mechanics behind the phenomena. The audience will look into yesterday and enjoy some of the memorable eclipses of the past, to learn how they changed the course of history.

April 12 is the date of the first of two total lunar eclipses occurring this year. On April 28, there will be a partial eclipse of the sun.

## **CONSERVATION**

#### **The Legislative Front**

HEARINGS are now under way in the House of Representatives on the budgets for the various government departments, and this is the time for conservationists to let themselves be heard.

Although Congress authorized \$500,000 last year for the purchase of lands within the Superior National Forest, to save the wilderness character of this area from destruction by resort developments, there is only \$100,000 for this purpose in the current Forest Service budget. This is no time to temporize with the very serious threats that exist to the whole future

of the Quetico-Superior wilderness project. The budget should be amended to make the full amount of the authorization available at once to the Forest Service. Also, this is the time to insist that provision be made for an intelligent and co-ordinated management of the wildlife of our National Forests. A start in this direction can be accomplished by restoring to the budget the item of \$165,000 for a Division of Wildlife Management within the Forest Service, which was dropped several years ago as an economy move.

For years Congress has failed to meet

*Continued on page 192*

*NATURAL HISTORY, APRIL, 1949*



# NATURAL HISTORY

*The Magazine of the American Museum of Natural History*

F. TRUBEE DAVISON, President

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VOLUME LVIII—No. 4

APRIL, 1949

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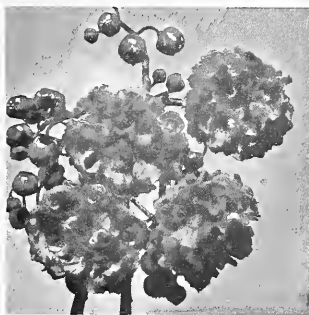
*They once poured south through what is now Chicago, and  
they may do so again*

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*The thrill of observing the marvelous creatures that make it  
may be a richer reward than finding the golden treasure*

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*A prize puzzle*



## THE COVER THIS MONTH

These gorgeous yellow flowers, which are sometimes four inches or more in diameter, adorn the spectacular and peculiarly shaped tree known scientifically as *Cochlospermum* (or *Maximiliana*) *vitafolia*. It is particularly distinctive because when all other plants and trees are dying, it bursts into full bloom, and its beauty lends a golden life to a dying landscape.

Its numerous seeds are clothed with a silky down. The tree grows in rather dry areas in Cuba and follows the Pacific coast of Mexico to northern Colombia, northern Venezuela, and southern Ecuador. It has been planted for ornamental purposes in the Virgin Islands and Puerto Rico, where this color photograph by Alonso Aguilar, Jr., was taken.

You will find NATURAL HISTORY Magazine indexed in *Readers' Guide to Periodical Literature* in your library

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Atherlie E. Karp, *Editorial Assistant*.

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## HOW TO KNOW THE BIRDS

An Introduction to Bird

Recognition

----- by Roger Tory Peterson

Houghton Mifflin Co., Boston, \$2.00

144 pp., 4 colored plates, numerous

drawings by the author

PETERSON'S well-known eastern and western field guides have done more to promote the hobby of bird study than any other publications of recent years. Nevertheless, the mere beginner who consults them to find the name of some bird he has seen is often bewildered by the hundreds of kinds of birds confronting him. The present little volume is intended to give such individuals an introduction to the methods of field identification. The importance of placing a bird in its correct family before proceeding further is emphasized. As the author remarks, no experienced birder compares a reddish duck with a reddish sparrow. He first determines whether a bird is a duck, a sparrow, or a member of some other group by careful observation of its actions, call notes, general appearance, and preferred habitat. To aid in doing this, various habitats are described and the birds to be expected in each are enumerated. Bird silhouettes are used to emphasize the importance of outline and posture in identification.

To permit application of the above principles the families of birds of eastern North America are briefly reviewed. The better known species each receive a few words of comment and are figured. In the more difficult or numerous groups only the plumages of the adult males are considered. This book should enable anyone to identify many of our more conspicuous birds and while doing so to become qualified to tackle more difficult species with the aid of the *Field Guide* or other manuals. Although intended primarily for beginners, *How to Know the Birds* will be valued by many others because of the numerous illustrations and the fund of general information scattered through its pages.

DEAN AMADON.

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## AN AUSTRALIAN WILD FLOWER BOOK

----- by Charles Barrett

Geoffrey Cumberlege,

Oxford University Press, Leighton House,

Melbourne, \$3.00

205 pp., 47 illu.

THIS little book is for the rambling reader not necessarily trained in botany. It moves along at a pleasingly fast pace in discussing the wattles, gems of the bush, heathlands, western wild flowers, orchids, alpine gardens, Tasmanian flora, beautiful shrubs, wonder-plants, and ferns—to give you a résumé of all the chapters—and is a “companionable guide to Australia's wild gardens.”

All in all, about 13,000 species of flowering plants are native to Australia, about four-fifths of which are restricted to that continent. Here and there are observations as to how these wild plants do under cultivation and notes about botanical discoveries of the early explorers. The pirate William Dampier made the first botanical collection; and so remarkable was the assemblage of species around a place called Sting-ray Bay that Captain Cook changed its name to the well-known Botany Bay. Among the “wonder plants” are included the pitcher plant (*Cephalotus*), Queensland's upas tree (*Pisonia Brunonian*) which sometimes catches small birds on the sticky fruit, a subterranean orchid (*Cryptanthemum Slateri*), and the “weird-looking drumstick grass tree” (*Kingia*). For American readers, who are too often fed upon cut-and-dried literary vegetation and care little “for text-book botany, yet desire to know more than the popular names of plants seen on their rambles, and are interested in little biographies of species,” Barrett's book should be an inspiration.

H. K. SVENSON.

## THE STARS ARE YOURS

----- by James S. Pickering

The Macmillan Co., \$3.95

264 pp., 23 photos

IN *The Stars Are Yours*, James S. Pickering presents a simplified approach to astronomy. No higher mathematics is used, and involved scientific explanations are omitted. He begins with objects that may be seen with the unaided eye and points out that from this standpoint “there aren't so many different kinds of things to be seen in the heavens.” Per-

haps from a beginner's standpoint this is true, and most certainly this book is written for a beginner.

The solar system is first discussed starting with the sun. Each planet is then taken up in the order of the distance of its orbit from this central body, with the asteroid belt and the satellites of each body introduced in their proper places. The author misses few opportunities to bring in interesting discoveries, such as that of Olaus Roemer relating to the speed of light. Roemer observed the occultations of one of Jupiter's satellites and “noticed a peculiar discrepancy in the length of time it took the same moon to make the passage across the far side of Jupiter.” The author concludes his brief discussion of the solar system with a discussion of the orbits and motions of the planets, comets, and meteors. The transition from this system to the stars in the regions beyond is accomplished by a series of excellent reproductions of photographs taken by some of the leading observatories.

The next step is logically the stars. These are introduced with their system of designation and magnitude. After a short briefing in the meaning of such things as stellar distance, size, mass, star motions, spectroscopy, and the telescope, the matter of star charts and constellations is discussed and illustrated at great length and in some detail. Appended are useful tables, lists and names of stars, and a brief discussion of the southern sky. Quite a few errors appear in the text.

GORDON A. ATWATER.

## A New Theory of HUMAN EVOLUTION

By SIR ARTHUR KEITH

EVER since man's kinship with the apes was recognized, there has been controversy over the nature and habitat of his pre-human ancestors and the causes which led to their evolution into *homo sapiens*. Now Sir Arthur Keith, in a book finished, as he tells us, on his eighty-first birthday, gives us the results of his years' study of these questions. \$4.75

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## A HANDBOOK OF THE BIRDS OF WESTERN AUSTRALIA

----- by D. L. Serventy and  
H. M. Whittell

Paterson Press Ltd., Perth, Western  
Australia, 15 shillings  
365 pp., 32 figs., 2 color plates

**F**EW readers of *NATURAL HISTORY* will ever be fortunate enough to travel to Australia. But even the others, so far as they are bird minded, will be interested in this very competent and practical handbook of Western Australian birds. It is the first thoroughly up-to-date Australian bird book. Though each species is adequately described, with due consideration to the diagnostic field characters, the emphasis throughout is on the bird's biology. In fact, it contains a convenient summary of the most recent literature on the life histories of Australian birds. The conservationist will find much of interest in this volume. On the ground that it kills lambs, bonuses on 94,090 heads of the magnificent Wedge-tailed Eagle were paid between 1928 and 1948. 57,034 emus were destroyed in 1935 during a seven-month period. In January, 1946, during a single shoot, no less than 960 ducks were killed, including 40 of the rare Freckled Duck, a bird unrepresented in most museums. The authors' vigorous interest in conservation gives us hope that such excesses will not recur in the future.

The introduction includes a most interesting and readable history of Western Australian ornithology and a section on bird geography. There are two colored plates and 32 figures in black and white (including 9 distribution maps). I can recommend this volume without reservation.

ERNST MAYR.

## FLOWERS OF PRAIRIE AND WOODLAND

----- by Edith S. Clements

H. W. Wilson Company, \$2.25  
83 pp., 24 color plates

**T**HOUGH the plates have become a bit anemic (due to overprinting, I suspect), this volume is a handy compendium of the color plates that appeared some years ago in the *National Geographic Magazine*. A few, such as the bird's-foot violet, are badly off color, and the pink gerardia (*Gerardia tenuifolia*)

is certainly not correctly named. An attempt to show the evolutionary series from Buttercups to Asters gives a complacent version of the subject, about as far or perhaps a little farther than one would wish to go without controversy. But the accompanying notes provide a good deal of information about plant families and the characteristics of individual species portrayed in the plates. The amateur can leaf through this book and by means of the illustrations establish for himself a pretty good foundation for recognizing members of the chief plant families of the temperate region; since the whole area from California to Maine is covered, this applies also to the professional. Refreshing touches appear, such as the name "Spring Lily" for *Erythronium*. There is much information that is interesting and unusual, and at such a reasonable price the book should be accepted in the comprehensive spirit in which it is written.

H. K. SVENSON.

## SWEEPER IN THE SKY

----- by Helen Wright

The Macmillan Co., \$4.00  
253 pp., 3 illu.

**S**WEEPER IN THE SKY by Helen Wright is a biography of Maria Mitchell, whose life span was from 1818 to 1889, a period fraught with the beginnings of Woman finding a place for herself in the world outside of her home.

She was brought up in a strict Quaker home in Nantucket Island, 30 miles from the coast of the mainland, where the great bulk of the United States is referred to as the Continent and where everyone is interested in celestial navigation because the men made their livelihood by sailing the seven seas.

One of the most vivid impressions of her childhood is that of bending over a chronometer, steadily counting for her father the moments preceding an annular eclipse in February, 1831. As the author says, "Maria Mitchell, 12 years old, was never to forget that eclipse—the darkness, the stillness, the dawning sense that she was a part of a great and orderly universe." Very early her father realized that "this child's eyes were unusually sensitive to variations in color and form," a fact that certainly contributed to her amazing success as an astronomer. In 1846, she discovered a comet which made her the first recognized American female astronomer. Many lasting friendships were gained out of this discovery as well as a medal from the Danish king. A trip to Europe followed, on which she met all the great astronomers of the continent.

Besides her work with astronomy, she taught school and served as librarian in the Athenaeum, where such people as Emerson, Melville, Lucy Stone, Horace Greeley, and many others came to lecture.

Finally came her work as the head of

the Astronomy Department of Vassar. Here she taught her girls to sweep the sky and to gain the companionship of women studying together.

Miss Wright has written a book that should have broad appeal because it is not technical, but it falls short of making Maria Mitchell, herself, a very interesting person. However, her picture of the nineteenth century and of woman's place in it is very graphic and extremely interesting.

GORDON A. ATWATER.

## THE PARASITIC CUCKOOS OF AFRICA

----- by Herbert Friedmann

Washington Academy of Sciences,  
Washington, D. C., \$4.50  
204 pp., 10 plates

**M**OST birds give devoted care to eggs and young, but among others the duties of parenthood fall entirely upon one sex. Several small groups of birds even avoid the trouble of incubating their own eggs, depositing them instead in the nests of other species.

The common cuckoo of Europe is famous for this "brood parasitism," of which our own cowbird is another familiar exponent. As a graduate student at Cornell University, Dr. Friedmann made a brilliant study of the cowbird and later traveled in South America and Africa to expand his researches. Africa has no fewer than fourteen parasitic species of cuckoos.

In the present book he supplements his own observations with all the reliable published notes and with information furnished by friends. He discusses and describes all these parasitic cuckoos and in addition gives detailed evidence about more than a hundred other African birds that have been reported as "fosterers" of young cuckoos.

Parasitic cuckoos certainly had ancestors that built nests and reared their own young. In Africa none now shows any intermediate stage in behavior, save that three of the smaller kinds sometimes feed young they did not rear. Careful



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study of unusual cases must throw new light on general problems of bird behavior.

Each species of parasitic cuckoo appears to have a special list of fosterers. The great spotted cuckoo prefers members of the crow and starling families; the didric cuckoo most often victimizes weaverbirds. Of a few sylvan species, almost nothing has yet been learned.

Since ancient times, men have wondered about the strange ways of the European cuckoo, but during the past 40 years much of the mystery has been cleared away. Now we are shown by Dr. Friedmann what an inviting field awaits similar investigation in tropical Africa.

JAMES P. CHAPIN.

## DANA'S MINERALS AND HOW TO STUDY THEM

- - by Cornelius S. Hurlbut, Jr.

John Wiley & Sons, \$3.90  
323 pp., 387 illusts.

SINCE the Yale mineralogy books have been turned over to Harvard for revision, it is not unexpected that the small popular mineral identification work published by E. S. Dana in 1895 should be revised and brought up to date by Dr. Hurlbut, who has already revised the larger *Manual of Mineralogy*. The new edition has attempted to retain some of the atmosphere of the older work, as well as its popular approach. However, the rewriting is extensive and has made the book considerably easier to read; in fact, this edition amounts almost to a new work. There are long sections on the determinative work of mineralogy, the recognition of crystal shapes, the use of the blowpipe, and the methods of performing the other tests. At the end there are determinative tables arranged to eliminate unknowns on the basis of their luster, hardness, color, and gravity. In between we find a selection of common minerals described in greater detail.

The position of this book has always been equivocal, and the revision has not much clarified the situation. Hurlbut is an authority in his field; hence, the facts are correct and often interesting. However, the mineral list is so abbreviated that one wonders about the value of the book. In the *Manual* will be found sufficient instruction on testing and a longer list of minerals. However, one cannot recommend a book when the collection it suggests for a beginner places andalusite in its major group and relegates one of the Mohs' hardness scale minerals, topaz, to a lesser rank. The first nine minerals of the hardness scale are fundamental for any collection. Mr. Dana, in 1895, may have thought himself fortunate to have "a skillful wood-engraver Mr. W. F. Hopson" for some of his illustrations, but they only detract from the modern appearance of this edition. Most collectors pick up hints on how to col-

lect, catalogue, and arrange minerals from their fellows, and they do not need instruction in these aspects. For the absolute beginner with no contacts and no opportunity to see collections made by others, this book will undoubtedly have some value, but for the average person it does not seem to be as useful as Dr. Hurlbut's revision of Dana's *Manual of Mineralogy*.

F. H. POUGH.

## AZALEAS, KINDS AND CULTURE

- - - - - by H. Harold Hume

The Macmillan Co., \$3.75  
199 pp.

AZALEAS are fascinating plants, and much has been written about them. The latest addition to the literature on this topic is a well-balanced, instructive, and entertaining book that will be of interest to everyone who grows Azaleas or would if he could.

The author describes the various kinds of Azaleas, has something to say on their countries of origin, comments on soil requirements, discusses the need for water, shade, fertilization, et cetera, et cetera. Certain varieties may feature plantings out-of-doors, and others need a greenhouse (if winters are cold) to find their ultimate expression in a floral abundance exceeded by no other group of plants. So extensive is the range of variation found in Azaleas that almost every location that will grow a plant will prove a happy home for certain species of this large group.

This variation covers size of plant and habit of growth, color of flower, permanence of foliage, temperature tolerances, and other less obvious characteristics. Some Azaleas are easily grown; others are difficult. All are beautiful and desirable plants; but, of course, some are better than others. To one familiar only with the spectacular bloomers, the more modest and retiring species may appear as drab as country cousins, but in reality the quiet relatives repay a closer acquaintance.

Azaleas are a challenge to any gardener with the space and means to indulge a plant hobby. Their appeal is immediate, but the hold they may take is insidious. So many beautiful kinds to choose from, such a gratifying response to the proper care, and finally what tragedy when the winter snows depart and one discovers that rabbits, too, like Azaleas.

Mr. Hume, in his book, provides the proper background for the successful study, growth, and appreciation of Azaleas. With its splendid illustrations, the book is enjoyable reading even for those who cannot play in the dirt. And a single reading will not dispose of this book, for it is of a sort frequently used for reference.

H. E. ANTHONY.

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## The Last Refuge of Sanity?

# Ecuador and the Galápagos Islands

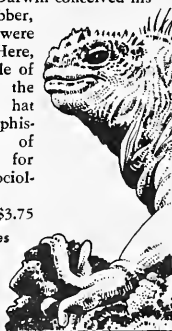
by Victor Wolfgang von Hagen  
author of *Maya Explorer*

IS it a luring, fertile land of untold resources — or a violent paradox where ancient civilizations battle with new? This stimulating, informal book recreates its colorful past—where Alexander von Humboldt sailed along its shore . . . where Darwin conceived his theories . . . rubber, quinine, platinum were discovered . . . Here, too, are the people of Ecuador today: the headhunters, the hat makers, and the sophisticated residents of Quito. A "must" for anthropologist, sociologist, historian.

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FOR miles the road had grown ever more difficult. Already we had bounced and swayed and jolted almost endlessly over its troublesome irregularities. We had plunged and bumped across any number of "sand luggers," or dry stream beds, but now we had reached what appeared to be the very grandfather of them all—a 300-yard-wide bed of treacherous white sand that shimmered in the oppressive heat and offered a most insecure footing for wheeled vehicles. For part of the way across it, the track had been improved with

◀ A TURKANA POLICEMAN, who proudly sports an ivory lip plug. The Tribal Police are recruited from the Turkana

▼ THE DUST AND NOISE of a lively dance are irresistible to the Turkana. A colorful performance was enacted for the expedition by special arrangement





# Among the TURKANA

The story of a recent expedition among a tribe that lives in the arid and remote northwestern portion of Kenya Colony in East Africa

By LT. COL. and MRS. WILLIAM J. MORDEN

*Leaders of the Morden African Expedition  
of the American Museum of Natural History*

*All photographs by Morden African Expedition*



▲ ONE OF THE SAFARI CARS deep in the sand near Lake Rudolf—an oft-repeated situation in the Turkana country

a kind of corduroy made of the branches of such trees as could be found round about, but we could keep going only as far as the corduroy extended. No sooner had our first car left the uncertain "pavement" of branches than it settled axle deep in the dry sand and refused to budge.

We had arrived in Cape Town from New York two months earlier and since that time had driven north over almost 4000 miles of good, bad, and indifferent African roads. We had motored east and north to Natal and the Orange Free State. We had crossed the Transvaal and Southern Rhodesia. We had visited Victoria Falls and driven the full length of Northern Rhodesia. We had crossed Tanganyika Territory and now, having entered Kenya Colony from the south, had finally reached its arid northwest corner—the bare and remote land of the Turkana, where our expedition's most important work was to be done.

Our party was not small. With us were Kepler Lewis, the expedition's anthropologist, who had accompanied us from New York; a white hunter and a white mechanic, who were in charge of our four motor

cars and other safari equipment; and our seventeen native "boys."

And now we had reached the Turkana country. Our road had run through the beautiful Kenya highlands, skirted the slopes of distant Mt. Elgon, and continued down the mighty escarpment of the Rift Valley. Here, with our ultimate destination not so very many miles away, we were crossing a dry region featuring thorny trees, equally thorny bushes, and a curious variety of anthills standing some 20 feet high and peculiar to this region. In fact, this was an especially unattractive place in which to get stuck!

Up to now any casual observer would have assumed that there was no native life whatever within miles of us. We had caught occasional glimpses of a few individuals along the way, but there had been no apparent signs of any for some time. Nevertheless, bare and arid though the country was and deserted though it seemed to be, we were about to have our first important contact with the people we had come so far to see.

Little obscured the nearer view except some groups of acacias and other thorn trees. There seemed to be practically nothing that anyone



➤ THIS BORINGO SUK FAMILY was intrigued by bits of American costume jewelry carried by the expedition for trade purposes



▲ TERMITE HILLS like this one lend a touch of fantasy to the arid Turkana landscape. Some were about 20 feet high

could have been hiding behind. Yet, to our surprise, natives we had failed to see now began to materialize. Where they came from it was hard to say, but in a matter of minutes they began to arrive. For the most part they were utterly naked, though a few wore loose, toga-like robes of brown cloth that were knotted picturesquely on their shoulders. Every one of them had some fantastic headdress. Their hair was heavily daubed with mud and was arranged on the backs of their heads in strange, bunlike masses to which ostrich feathers gave the final decorative touch. Naked though most of them were, they went in strongly for "costume jewelry," and besides leg

bands of gazelle hide, they wore necklets of beads and wire, earrings, bracelets, and lip plugs made of ivory or metal. But despite the savage picture they presented, they had all the good nature in the world, and they turned to with a will to dig us out with their bare hands. One chap actually ran, in the broiling sun, all the way to their somewhat distant little village to get a couple of shovels that must have been rare and valuable implements among these simple people. Much sand was dug out from around our wheels, and armfuls of branches were gathered from several of the bare surrounding acres to form a new foundation. After an hour or so, a group of natives pushed strenuously, and the car finally climbed out of its sand trap and struggled uncertainly across the treacherous, dry stream-bed to firmer ground.

Our immediate destination was a little government post that lies within 100 miles or so of the Abyssinian border and about 45 miles west of Lake Rudolf—a place called Lodwar, where a few white administrators and a small group of native police look after the welfare of the inhabitants of some 35,000 square miles of this barren region. And, at last, we made our weary way into that remote outpost of

Empire on the afternoon of the twenty-eighth of June.

One of the basic reasons for the location of Lodwar, no doubt, is the Turkwell River, which is dry for much of the year but in whose bed, as the natives long ago learned, wells can be dug. It was not far from the main well in this usually nonexistent stream that we chose our camp site—a pleasant spot in a grove of wide-spreading thorn trees. Because this was to be much more than merely a temporary, overnight stay, everything was set up with especial care and with more than usual thought for our comfort and convenience. The spot we chose was convenient, as well, to the government *boma* (the District Commissioner's administrative offices), the Lodwar fort, and the few other structures of the tiny settlement. Even before the final details of making camp had been completed, we set off to pay our first call on the officials in charge of this extensive but thinly populated district.

We were cordially received by District Commissioner Whitehouse in his attractive and somewhat imposing flat-roofed house, which had been built, in the absence of any other structural material, of bricks made on the spot. We also met two other officials of the post who hap-

▼ AN OUTPOST OF EMPIRE: the *boma* at Lodwar, administrative center of the district. Only a handful of white men and three white women—one the wife of a former commissioner—had ever reached this spot



pened to be there at the time instead of off on tour of the district, and a visiting "locust control man." From them we learned something we already knew reasonably well—that we were far off the beaten path in a land to which few outsiders had ever come. Only a handful of white men and, we were told, only three white women—the wife of a former commissioner and two of her friends—had ever reached Lodwar.

Our purpose in coming to this region was to study, photograph, and collect among the Turkana. Mr. Whitehouse, himself deeply interested in the welfare of these natives, assured us that he would be glad to help in every way possible. He immediately assigned one of his tribal policemen (members of the Tribal Police are recruited from the Turkana) to accompany our party during our stay in the district. Our policeman was named Loichamba, and he was a sturdy chap of splendid physique, with

the usual fine carriage of these natives. His uniform consisted primarily of a neat blue cloth kilt edged with red, bearing in front the initials T.D. for "Turkana District." He also wore a headdress of ostrich plumes, a large pair of metal earrings, and an ivory lip plug as big as a ping-pong ball, which stood out vividly before his black chin. As we were shortly to learn, Loichamba was as useful as he was ornamental. He came to be of the greatest assistance in our work, accompanying us on all field trips and spending the rest of his time in our camp, representing "The Law."

The detailed studies that the expedition was to make were certain to be time-consuming and difficult. Before turning to that phase of our work, however, we were anxious to visit Lake Rudolf, which, surrounded by this arid portion of northern Kenya Colony, is undoubtedly one of the world's least-known extensive bodies of water.

▼ A LODWAR DANDY. In addition to other accouterments, the Turkana carry seven- to nine-foot spears

► A TURKANA WOMAN in full dress, showing the native mode in arm bands, necklaces, and ear decorations. The hair is shaved on both sides



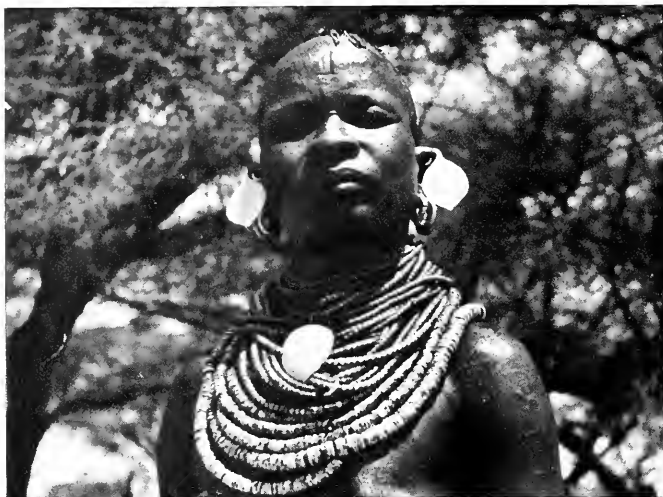
AMONG THE TURKANA



Unlike East Africa's other great lakes, Lake Rudolf has no outlet. Lying some 250 miles northeast of Lake Victoria and reaching northward into Abyssinia, it is fed by the Omo River and some smaller streams that flow from the north, as well as by the usually dry Turkwell River, which rises on the northern slopes of Mt. Elgon and floods down toward Lodwar during the rainy season. Not yet truly a salt lake, it has come, in the course of time, to be something less than fresh, though its brackish waters are somewhat unpleasantly drinkable. Too, it is slowly shrinking, constantly giving up by evaporation just a little more than it gains from the streams that feed it. Unlike most of Africa's other great

lakes, its surroundings, except perhaps in the north, have little to recommend them. When one considers its remoteness and the harshness of the surrounding country, it is not surprising that Lake Rudolf, which was discovered only in 1888, is so little known and so seldom visited. At Lodwar, however, we were within 45 miles of its western shore, and we felt impelled to visit it.

On the third day after our arrival at Lodwar we started for the lake. Leaving several of our "boys" behind to keep the camp in order, we left in the morning with two safari cars and one truck, accompanied by the Assistant Superintendent of Police, Mr. Griffiths, and our Loichamba. We were quite conscious that difficulties lay ahead. The road was a mere track in most places, but a month or so earlier the Commissioner had driven over the route, and we followed the faint trail he had left. Time after time we sank deeply into the heavy sand and had to be dug out. Under the strain, one of the cars broke down, and we had to send back for repairs. Thus it was well along in the afternoon before we finally



▲ A TURKANA HOUSEWIFE with her treasure of beads made of ostrich eggshell. Note also the earrings and discs

came to a halt amid the sand and scrub about a mile and a half from the water's edge. We had ridden as far as our cars could take us but still had some distance to go.

We were bound for a little fishing camp that an earlier commissioner had built on a sandspit a

short distance out in the lake. It was a simple place, consisting of nothing more than a few thatched huts, or *bandas*. In order to reach it, we had first to reach the lake shore and then to cross the shallow intervening stretch of water in a small, flat-bottomed skiff.

It was fiercely hot there in the scrub, but, as had happened before, a considerable gathering of Turkana quite suddenly appeared. They no sooner learned that our duffel had to be carried to the lake than they wanted to help, so shortly we were on our way—a long, irregular foot safari, with bundles and packages of varying shapes and sizes balanced on almost every mud-daubed head.

So shallow was the water where we reached it that we had to wade out for 50 yards or more to the rowboat, and many trips were necessary before our luggage, our bedrolls, our supplies, and ourselves were finally delivered beside the *bandas* on the sandspit. Our arrival startled thousands of bright pink flamingos into the air, and almost as many big white pelicans. As the great birds wheeled and fluttered above the sandspit and over the vividly blue water of the lake, they seemed to shimmer in



▲ THE GIRLS MUST water hundreds of goats and cattle from river-bed wells like this. Sometimes the water is 20 feet below the surface

their flight until it was hard to distinguish one bird from another.

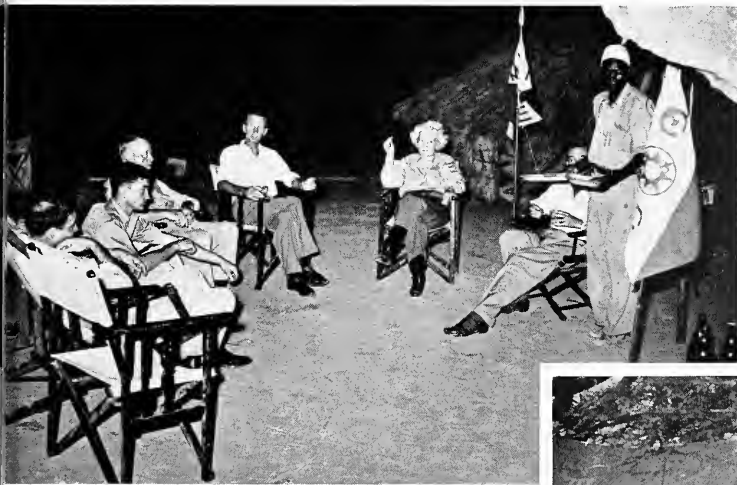
The sandspit supported almost no grass. In fact, there was little vegetation of any kind except a few clumps of palmetto scrub that rattled dryly in the breeze. But we had no sooner dropped into our camp chairs in the welcome shade of the thatched roofs than the natives went to work to prove what a fisherman's paradise this remote spot actually was. Dinner that evening—yes, and all the other meals we had there—revolved primarily about dozens of freshly caught *tilapia*, or perch, a fish that exists in the lake in enormous numbers. The ones we ate were small, but some varieties grow to immense size. A hundred-pound Nile perch, we were told, is not uncommon, and we were assured that others much larger had been caught here. Incidentally, the fact that Nile perch are common in landlocked Lake Rudolf suggests that the lake may once have had an outlet to the Nile.

It seems strange that a region offering so little in the way of vegetation should be so rich in life that

is dependent upon these brackish waters. Never for a moment while we were on what we called our enchanted isle could we fail to be conscious of the countless lovely birds. The fishes, which can be caught so readily with seines and fish traps, must be almost unbelievably numerous, and they, in turn, may explain the presence of the crocodiles. We saw any number of them as they floated silently past, not far from shore. None visited the sandspit while we were there, but we found their eggs in the sand, and they must regularly come ashore in large numbers somewhere thereabouts. Hippos, too, were in the vicinity, rising and sinking from time to time out in the lake. They seemed to be watching us, and the natives assured us that they were merely inquisitive and were kindly disposed toward visitors. Certainly they had no hesitation about coming ashore near camp during the night. We heard them grunting, and on our second morning we found their tracks within 30 feet of our huts, though they had returned to the water before dawn.

The morning we started back for Lodwar we found our new friends, the local Turkana, waiting for us on the shore. Once more they helped us carry our belongings back to where the cars had been left amid the sand and scrub. This particular group of natives, it was said, had formerly been unable to care for themselves because of the great aridity of the region in which they had previously lived. Consequently, by government direction, they had been listed as registered paupers and had been brought here to the shore of the lake in order to be taught to fish. Curiously enough, despite the many fishes in the lake, the Turkana were not inclined to draw to any great degree upon this supply of food. Thus, in the comparative absence of other food supplies, some of them had suffered from dietary deficiencies until the situation was largely corrected by the use of more fish, and especially of more fish livers, which, in the past, these Turkana had discarded. Their general health had thus been improved, and under the direction of a government-trained native "fishing expert," these people are now learning how to live—and to live reasonably well—on fish, together with such products as the nuts of the dom palm, which they grind and cook. They are pitifully poor, of course, for their only commercial product is a small amount of rough camel rope, which they make from the fibers of the palm. So when we rewarded them for the help they had given us by distributing some 30 pounds of strong trade tobacco, which they love, they were almost pathetically grateful.

Our return to Lodwar, except for



▲ MRS. MORDEN was hostess to the District Commissioner at the expedition's Lodwar camp

➤ A PLEASANT SPOT in a barren land: the camp beneath wide-spreading thorn trees at Lodwar





▲ HARRY SELBY, assistant hunter, with two Nile perch he caught in Lake Rudolf. Some weigh 100 pounds or more

frequent difficulties in the sand, was almost entirely uneventful. On the way, however, we came across a herd of Grant's gazelles and tried, as best we could in that rough going, to "pace" one of them. We got our car up to 35 miles an hour on a fairly level stretch, but the animal we were following suddenly decided to leave us behind. It outdistanced us so rapidly that we estimated its speed at not less than 45 miles an hour.

By now we were ready seriously to begin our work among the Turkana. Already we had made quite a beginning on the motion picture record, and Mr. Lewis had a good start on his collection of spears, knives, and shields, earrings and lip plugs, anklets, necklets, and various other bits of decoration, costume, and equipment.

The Turkana, we learned from the British administrators, are divided into some sixteen territorial groups, but their divisions and subdivisions do not end there. There are 28 different blood groups (clans) based on paternal relationships; and other group organiza-

tions variously subdivide this widely scattered tribe. There is a chief for each Turkana group, and a headman for each subgroup. Natives pay their taxes on the basis of clan membership.

The aridity of the country necessitates a nomadic life, and the villages are not in reality villages at all. They are always temporary, being composed of nothing more than crude huts of branches, leaves, and grass. Furthermore, each is inhabited only by a family group—a man with his wives, children, and such other relatives as are not at home elsewhere. No such group is apt to include more than a score—or, at most, two score—of people.

The men are often very tall, many well over six feet. These taller ones are inclined to be very slender, but there are others who are not only noticeably shorter but also sturdier, more muscular, and more given to Negroid characteristics, which are less evident among the taller individuals. Loichamba was of this stocky type. The women, in general, are some four to five inches shorter than the men.

The Turkana subsist, for the most part, on their cattle, sheep, goats, camels, and donkeys. They milk all these except the donkeys. Milk actually forms one of the most impor-

tant parts of their diet, and they not only drink it fresh but also after it has soured. They eat clabbered milk, too, and make a kind of liquid butter called *ghee* (a Hindustani word) which serves them both as food and as an oil with which they grease themselves. They pay almost no attention to agriculture, and the British administrators have been unable to interest them in widening their vegetable diet. The country does not really lend itself to agriculture, but even in the stream beds where a few things could be grown, they raise nothing but a little kaffir corn. The dom palm and a few berry bushes supply them with some food. The Turkana often bleed their animals, catching the blood in wooden bowls and mixing it with milk or consuming it raw and fresh.

The men and boys tend the herds, and the women milk and water the animals. Sometimes the very small boys help the women with these tasks but not after they have reached adolescence. In the absence of natural water holes, wells have to be dug in the beds of the usually dry streams. The water is sometimes found in holes no more than five or six feet deep, but we saw several that went down twenty feet or more. The task of passing the water up from the bottom of these



▲ THE NATIVES, loving the out-of-doors, spend little time in their sleeping huts. The villages rarely include more than 40 people



big pits in bowls seemed ordinarily to be performed by girls, who poured it into little wooden troughs from which the herds drank.

The weapons carried by the men are comparable to those carried by other East African tribes. The spears, which have leaf-shaped blades, are generally from seven to nine feet in length. The shaft is made of wood, and the tip of the handle, as well as the blade, is made of iron. Usually these are carried in well-matched pairs, and the points, when not in use, are protected by leather covers. Every man also carries a club which is not unlike a hockey stick in shape. Many of them wear wickedly effective knife finger rings; and circular, bracelet-like knives are worn on the wrist. These are ordinarily protected by leather sheaths.

Religion seems to have no very important part in the lives of the Turkana, although they appear to reverence a high god. They do not seem to subscribe to formal beliefs and prayers, but some witchcraft is practiced. Its details, however, are hard to uncover, and witch doctors as such do not seem to exist. Still, as natives often try to conceal their secret beliefs and practices, it may be that some among them are credited with mystical powers and are designated as witch doctors.

Life is not easy in this remote land, but the Turkana nevertheless seem to be happy and good-natured. Among their limited pastimes, dancing is by all odds their favorite. They have dances during the day, and they have them at night. They sometimes even carry them on for days without apparent letup. There are hunting dances and war dances, dances that have to do with their herds, and others that are meant to bring good luck. And in all of them, everyone seems tireless.

One of the most interesting dances we saw was held at Lodwar, where it was arranged for us by the District Commissioner, and we were able to record a part of it in motion pictures. The story behind it was a pastoral one, and both men



▲ THIS YOUNG LADY is the daughter of a chief. The Turkana recognize 28 different blood groups based on paternal relationships

and women took part. Even the children hopped and skipped about the edges and were interested spectators, though not actual participants.

The dance began late in the afternoon, and it took the dancers some time to "warm up." There were, in all, about 100 of them from the country round about. A number of the men wore clusters of pink, white, and orange plumes, and some wore short goatskin aprons, wooden sandals, necklets and pendants of beads and ivory. Most of them were naked, however, except for the usual cloak of brown cloth knotted above the right shoulder or possibly an abbreviated skirt of cloth made by wrapping a length of cloth about the middle and tucking in the end at the waist. Some adorned themselves with wide arm bands of metal and other decorations of copper wire and even cowrie shells. Almost without ex-

ception they wore great lip plugs of ivory, bone, or metal in their lower lips. Some of these plugs, prominently white against their black chins, were little smaller than hens' eggs.

The women wore goatskin aprons front and back and decorated their ears heavily with great metal hoops or discs or with a series of small metal ear-hoops. There were necklets of beads and ostrich shell and anklets of iron. They also wore lip plugs, though these were smaller than those of the men, and some—long and thin as cigarettes—were made of copper wire or aluminum. The women shaved their hair on both sides of their heads, leaving a center section that was smeared with fat and wound into tight curls as if for a permanent wave. Sometimes these curls hung over the ears and forehead almost like a shiny rope fringe.

There was not a great deal about

*Continued on page 191*



◀ It is  
a shy little sparrow  
of the grassy fields

A bird with an  
insect-like voice

By  
GEORGE A. SMITH  
*Photographs by the author*

## Grasshopper Sparrow



THE grasshopper sparrow (*Ammodramus saviannarum*) is a common little bird in the eastern part of the United States, but because of its seclusive habits and its thin, insect-like voice it is not generally known. Indeed, its tone is very near the upper limit of human audibility and will, therefore, give you an opportunity to test your hearing. Many persons cannot hear the song at all. It is almost exactly like that of the meadow grasshopper and sounds something like *tsick, tsick, zee-e-e-e-e-e*. The grasshopper sparrow lives in grassy fields and seldom takes wing. When it does fly, it rises only a few feet above the ground.

The nest of the grasshopper sparrow is rarely found, because it is cleverly concealed under a covering of grass. To avoid giving as much as a clue to the location of its nest, the bird enters the immediate area by way of a devious pathway through the grass.

◀ ITS NEST  
is cleverly concealed  
under a covering of grass

➤ THE WHITE EGGS  
are spotted sparingly  
with black and a  
delicate shade of lilac gray

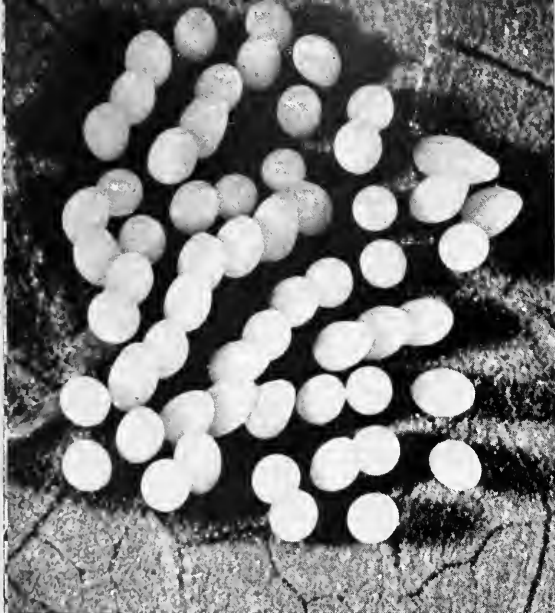


▼ THE DULL BROWN FLEDGLINGS  
are practically invisible  
in their grass-lined nest



➤ JUSTIFYING ITS NAME.  
The grasshopper sparrow  
lives on grasshoppers and smaller insects  
that are plentiful in grassy fields

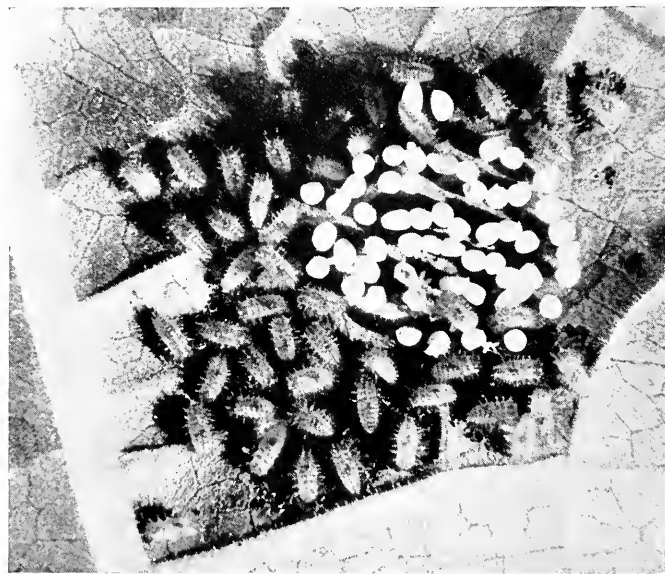




▲ A CLUSTER of 59 eggs of the Mexican bean beetle fastened by their ends to the underside of a bean plant leaf. Each is about as big as a pin-head

NEARLY 100 years ago when men had just started to study the insects of the western United States, they discovered a rather uncommon beetle in the semiarid regions of southwest Texas, southern Arizona, and northern Mexico. It was oval, nearly hemispherical in shape, about one-fourth inch long, yellowish in color, with small round, black spots, eight to each wing cover. This rather attractive little beetle was destined to become famous—or infamous—as the “Mexican bean beetle” and to rate as one of the potent scourges of the American gardener and farmer.

But in 1860 southern Arizona was the northern outpost of this beetle. Farther south, in the more luxuriant areas of central Mexico and of Guatemala, the beetle was much more plentiful, again disappearing in Panama where the climate was too humid for it. Some ten years earlier Mulsant had described this insect from specimens obtained in Central Mexico, although what are now known to be merely varieties he described under at least four different names. For many years



▲ HAVING EMERGED from the eggs in large numbers, the young Mexican bean beetle larvae begin devouring the bean leaf

entomologists knew it as *Epilachna corrupta*, but in the 1930's *E. varivestis*, which Mulsant had applied to the typical form, was accepted, and this name is used to the present time.

This beetle belongs to the Coccinellidae, commonly known as ladybirds or ladybugs. Unlike most of the Coccinellidae, which are car-

nivorous and feed upon aphids and scale insects, this group, including some other genera besides *Epilachna*, are phytophagous, or plant-eaters. This great difference has moved many students of insects to consider it advisable to classify these plant-feeding species as a separate family. Other biological and structural similarities are so

# MEXICAN Bean Beetle

The life story of an insect that rapidly made itself at home in most parts of the United States

By JOHN C. PALLISTER  
Photographs by LYNWOOD CHACE

marked, however, that the *Epilachna* and the others still remain as one of the major subfamilies of the lady beetles.

In their native home the insects fed upon a great variety of plants, largely of the Leguminosae or pea family. Some of the wild species of the beans were the ones generally consumed, but with the planting of the snap or butter beans in the gardens of the early settlers of the western states, the insects found a new source of easy living and developed quite a preference for them. The Mexican Bean Beetle was beginning to be noticed feeding on bean plants in the southwest United States as early as 1864, and by 1883 it was reported from Colorado as a pest. It spread rather rapidly throughout the western states until it ranged as far north as Colorado and Utah.

The mountains to the west stopped its spread into California, and the more arid plains to the east barred its progress in that direction. In 1920, the beetle was suddenly reported from three counties in north-central Alabama. It had made a commercial "jump" across this great distance, supposedly by means of a carload of alfalfa hay shipped from Colorado. By the end of that year the beetles were found established in thirteen counties. Government entomologists now realized that they had a serious pest to combat. A general quarantine to try to stop the spread of the insect was established. This quarantine had to be abandoned the next year because the insect had jumped the boundaries of the quarantine, and by the end of 1921, it had covered a vast area in northern Alabama, Georgia, and the eastern part of Tennessee. At the end of the next year it had spread into the western part of North and South Carolina, eastern Kentucky, and southern Ohio. In 1927, it had advanced to take in most of Virginia, Maryland, Pennsylvania, all of Ohio, part of

New York and Michigan, and it had even been found in isolated spots in Canada. By 1930, southeastern Canada and all of the United States east of the Mississippi, with the exception of a strip along the Gulf of Mexico, was overrun by this bug. It is strange that while it was pushing so rapidly north, the beetle did not seem to spread southward to any great extent, and even now it occurs only spottily in the extreme south. The environment seems not to be just right in this area for the development of this creature.

All this time, while extending its range, it was causing tremendous damage to the bean crop of the eastern United States. Heretofore, beans had been one of the most easily grown and productive of the staple crops of the country. People did not know how to combat this strange bug. The problem was brought vividly to my attention in the summer of 1926 while collecting insects for the Cleveland Museum of Natural History. I was working the hill country of southern Ohio, and it was in this hilly submarginal land that the failure of the bean crop meant disaster to the struggling, hard-working farmers. When it became known that

there was a "bug man" in their region (and news travels fast in these hills), delegations would assemble along the roads to waylay me to ask aid in saving their beans from the "yellow bug," as they termed it. I couldn't offer much help other than to suggest very thorough spraying with arsenate of lead.

The adult beetles come out of hibernation, where they have spent the winter months under collections of brush, trash, or leaves, as soon as settled warm weather arrives. Some may, however, delay their appearance until well along into summer. Because of this slowness on the part of the beetles, beans planted as early as possible after late frosts sometimes suffer less damage than those planted later. After feeding on the tender young bean plants for one to two weeks, the females start to lay their orange-yellow eggs, each depositing 500 to 600 of them in batches of 40 to 75 on the underside of the foliage. The eggs are elliptical, nearly twice as long as wide, and are carefully attached at the end so that they all stand vertically. They are about 1/20 of an inch long.

The eggs hatch in a week during warm weather but may require at



► THE LARVA is protected by six rows of black-tipped, branching spines



least two weeks under more unfavorable conditions. Out comes a whitish or yellowish larva covered with six rows of branching spines, black-tipped on the ends. It feeds voraciously for two to five weeks, depending upon the temperature. The feeding is almost always on the underside of the leaf, and this makes irregular patches on the leaves. The upper surface quickly dries out, killing the leaf. When first

hatched, they all feed together. If the leaf is somewhat dry, the first hatched may devour the remaining, unhatched eggs. As they grow older, they still retain their gregarious habits but tend to split up into small, scattered groups.

Their spines serve the larvae in protecting them from hungry birds. Chickens and guinea fowl, although feeding on other insects in a bean field, will pay no attention to this

spiny food. Toads also will not touch them. There are, however, some insects that do not mind the spines. Among these are tiger beetles and carnivorous ground beetles. Carnivorous stink bugs of the family Pentatomidae are known to spear these larvae with their long beaks and suck them dry. When full-grown, the larva is about  $\frac{1}{2}$  inch long.

It is now ready for its last larval molt. Like all Coccinellids, it fastens the tip of the abdomen to a part of the plant and starts to wiggle out of the larval skin, not entirely shedding it but pushing it back until only the tip of the abdomen remains in the skin. This is the pupal stage, which lasts for five days but may drag out much longer in the cool weather of fall. The pupa is yellowish and remains quiet until about to shed its skin in the pupal or last molt that the insect goes through.

It is the adult beetle that now emerges, but what a sorry looking creature it is! The wing covers, or elytra, are soft and flabby, pale in color, without the pretty black dots. It doesn't remain so for long. In a few hours the elytra have hardened.



▲ WHEN READY for the larval molt, the Mexican bean beetle does not wriggle entirely out of its spiny skin but is held by the tip of the abdomen remaining within. The adult beetle will emerge by breaking out through the upper surface of the pupa

➤ MAGNIFIED VIEW of the underside of the pupa. It has been detached from its fastenings on the plant for photographing







◀ ADULTS AND LARVAE of the Mexican bean beetle. Note the places on the leaf already eaten away. When the undersurface is consumed, the leaf quickly dries out and dies. These insects can kill the foliage of a bean plant in a short time

▼ THE MEXICAN BEAN BEETLE is one of the farmer's most destructive pests. This shows a magnified adult beetle feeding on the underside of a bean plant leaf. Spraying with one pound of magnesium arsenate to fifty gallons of water is recommended

The color has strengthened to a bright yellow, and the sixteen black dots have appeared. These dots are sometimes variable in size and number, which led Mulsant to believe he had at least four distinct species. We now regard these variants to be subspecies or geographical forms.

The adults are strong fliers and travel long distances hunting for new bean fields to devour, for they are almost as voracious as the larvae. Not only do they eat the foliage but sometimes even the pods and stems. They are comparatively safe from all natural enemies, for like all true Coccinellids, they exude a yellowish secretion from the joints of their legs, which is very ill-tasting. It would take a strong-stomached bird to make ladybugs a regular diet. This secretion will stain the fingers of anyone who picks up a lady beetle and may even irritate sensitive skins.

Although snap beans and field beans seem to be the favored food of the Mexican bean beetle, so much so that many home gardeners have given up trying to grow them, other members of the bean family are also attacked. Lima beans, cowpeas, soybeans, hyacinth beans, and closely related plants, such as alfalfa, kudzu, and sweet clover will serve as food if the bean beetle's favorite



food is not at hand. Bean growers have to wage a constant but none too successful war against these little pests. The use of arsenate of lead has given way to magnesium arsenate or calcium arsenate. One part calcium arsenate with four to eight parts hydrated lime is dusted on the plants. One fault of a dust

control is the difficulty of applying the dust to the undersides of the foliage where the insects are feeding. A spray control of one pound of magnesium arsenate to fifty gallons of water seems to be much the better, especially if the spray is directed onto the underside of the leaves.

# The Man Who Grabbed A Shooting Star

Ellis Hughes' skill  
and daring in  
moving a 15½-ton mass  
of solid iron  
ended in a  
curious tug-of-war  
in the law courts

By PAUL M. SEARS

►THE WILLAMETTE METEORITE—largest single shooting star found in the United States. When Hughes and his prospecting partner came upon it, they thought they had located an iron mine

Photos by AMNH

"GOE and cathe a falling starre . . .," taunted the poet John Donne. He figured it couldn't be done, and most sensible folks would agree. But 300 years later a resourceful Welshman named Ellis Hughes took the poet at his word, startling the scientific world and sending lawyers and judges scrambling through the legal records of bygone ages in search of a precedent—a precedent for the ownership of a falling star.

True, falling stars, or shooting stars (scientifically called *meteorites*), had been found before. Every respectable museum in Europe and America boasted a specimen or two, usually an unimpressive pebble-sized lump of rusty or blackened iron, sometimes with heavy stony material mixed in. It was Ellis Hughes' luck to stumble across a shooting star weighing 15½ tons—and then to run away with it. Perhaps "run" is the wrong word. But he indisputably packed up the thing and took it home, thereby providing certain Oregon lawyers with some lively professional exercise.

Before he tangled with shooting stars and judges, Hughes had been a miner in Wales and in Australia. He had learned his trade uncommonly well; otherwise he could never have made off with his staggering astronomical treasure trove.

In 1902, he came to America and settled with his wife and son in the dense, wet, still primitive forest along the Willamette River south of Portland, Oregon. The Hughes family lived modestly; the nearest neighbor was a mile away, and Ellis Hughes took plenty of time off for his hobby—prospecting for minerals around the near-by hills.

He had a prospecting partner named Dale. One day the two men came across a most peculiar rock, on a hillside within a mile of Hughes' home. Perhaps one of them actually stubbed a toe on the thing; more likely he spied it first and swung a tentative, testing mallet. The rock wasn't big, at first sight, but it was pure metal, rust-flaked and immovable. The result was wild excitement.

They began to dig. Hughes called the find a "reef"—a good Australian term for a treasure lode. They determined the metal was iron, for gold or silver would have been heavier. But the prospects for an iron mine seemed wonderfully rosy, even so.

Then they came to the end of the reef. They had dug entirely around a weirdly-eroded, bell-shaped lump of iron measuring ten by seven feet across and four feet thick. The lode, they figured, continued farther underground.



Dale and Hughes kept their find an absolute secret. They might have slammed their fists on the nearest bar and babbled the news that would have started another gold rush—or, in this case, an iron rush. Instead, they nosed around to discover who owned the land on which the “reef” lay. The answer, by coincidence, was the Oregon Iron and Steel Company, a concern with conveniently absentee ownership. Hughes and Dale hoped to buy that particular piece of land.

Then, after months of secrecy and suspense, they learned that their iron reef was actually a meteorite, the remains of a giant shooting star that in a past age had blazed to earth and embedded itself in this remote Oregon forest. The records do not say how they learned, but as a proper assay can always tell the difference between meteorite iron and any other metal, they probably had an assay made. Certainly they refrained from mentioning to the assayer that their sample had come from a 15½-ton mass, for the secret remained as well kept as ever.

But Dale lost his enthusiasm when this news showed that the iron vein could not possibly run farther underground. He left for Alaska and thereby missed his chance to share unsuspected—and unsettling—honors with Hughes.

Hughes’ home stood only three-quarters of a mile from the giant meteorite. The forest wilderness ensured privacy, and the distant neighbors kept to themselves. Hughes decided to fetch the great chunk of iron quietly to his own property. For motive power Hughes had himself, his fifteen-year-old son, and a run-down, undersized horse. Hughes’ other asset in this preposterous bid for glory was the

mechanical savvy he had picked up in the mines.

First he built a rough heavy-duty timber platform that rolled along on sections of tree trunks. House movers use similar apparatus to roll buildings down a road. He set this crude cart in place beside the meteorite and then levered the 15½-ton mass up and out of its resting place. Not without major difficulties, of course. But fortunately the deep pits and channels that eroded the face of the meteorite like wormholes made it easy to attach chains. Whenever he gained an inch, Hughes jammed another wedge between the meteorite and the bottom of the hole. Finally he capsize the monster directly onto the waiting cart and chained it down.

Then he found the horse couldn’t pull the cart. That would have licked most men, but Hughes thought he knew the answer. Sailors can’t pull up a heavy anchor by hand, so the anchor chain is tied to a vertical post with spokes sticking out for handholds. The sailors push the post around, and the chain winds up. It’s called a capstan. Hughes built a homemade capstan and set his horse to winding a wire rope around it. The other end of the rope tugged at the big cart with the ungainly meteorite

perched on top. The arrangement was so ingenious it deserved to succeed, and succeed it did, painfully and by inches.

The wet forest soil repeatedly mired the log rollers, and some days they were lucky to pull the cart its own length. Other days they did better, but 50 yards was the best day’s haul. From August to November of 1903, Hughes and his son and the small bedraggled horse thus toiled fantastically in the soggy forest. Finally they reached Hughes’ own land. Feeling safe at last, Hughes proudly announced his find, counting on publicity to bring buyers to his door.

Instead it brought trouble. True, a gratifying swarm of curiosity seekers trooped out from near-by Willamette and, when the news spread, from as far as Portland. But there also came a peremptory message from the Oregon Iron and Steel Company, demanding that Hughes give up the meteorite. Hughes pluckily replied, “Nothing doing,” and thereby set a lawsuit in motion.

The case came to trial in county court, and the decision quickly went against Hughes. But public sympathy and admiration were strongly on his side, and his lawyers appealed to the Oregon Supreme Court. By now many scientists were

*Continued on page 191*

► TRANSPORTING the meteorite to the American Museum—an easy job compared with Hughes’. He moved the mass almost a mile, with the help of only his son, a horse, a wooden cart, a capstan, and his own indomitable spirit





▲ BLACK-FOOTED ALBATROSS running for the take-off. It needs a head wind and must run a considerable distance to rise



▲ GAINING ALTITUDE after the take-off. Very few wing strokes are now needed

# Flight of the Albatross

ALBATROSSES may be regarded as creatures of the air rather than of the land and water; for although they are entirely dependent on the sea for their subsistence, they pass by far the greater part of their time flying. They remain for long periods well out of sight of land and appear to be almost entirely independent of both land and water for the purpose of resting.

When viewed for the first time by the ocean traveler from the deck of a vessel, an albatross never fails to excite wonder and admiration by its untiring and apparently effortless gliding. Its thorough mastery of the air represents one of the more remarkable achievements of nature in adaptation to a special environment.

Because albatrosses frequent the open expanses of the ocean and come to land only for a part of the year to raise their young, they are not familiar to most persons. They choose small and remote islands as nesting places—spots seldom visited by man. To the great majority of persons, therefore, they are reminiscent chiefly of stories of the sea and of Coleridge's immortal poem of the Ancient Mariner, in which we find reference to the supersti-

The king of sustained flight comes to land only to raise its young and is a thrilling sight for sailors in the unfrequented reaches of the sea

By THOMAS M. BLACKMAN

*Photographs by the author*

tion of sailors regarding the albatross—surely an outgrowth of their wonderment and admiration for these birds:

*And I had done a hellish thing  
And it would work 'em woe,  
For all aver'd I had kill'd the bird  
That made the breeze to blow.*

A fallacy has persisted right up to the present time in dictionaries and general reference books to the effect that albatrosses may attain a wing expanse of seventeen feet. In reality, the measurement from wing tip to wing tip varies from about seven feet in the case of several of the smaller species to ten or eleven feet in the Wandering Albatross, which roams the southern parts of the oceans around the globe. But a bird with a ten-foot wingspread needs no exaggeration when you see it at close range.

The spectacle is imposing at any time, but to observe the aeronauti-

cal skill of the albatross at its best you should see the bird following close in the wake of the ship or circling about it in sweeping curves when there is a stiff breeze and a rough sea.

The great bird takes a position perhaps twenty feet above the level of the deck and twice that distance behind the stern of the vessel, and follows for hours at a time, with its long wings outstretched and curved slightly downward. At intervals it may be seen to turn its head this way and that, as though scanning the surface of the water for anything edible that may have come to the surface. Occasionally it drops behind and floats buoyantly on the water, perhaps to pick up some-

➤ BLACK-FOOTED ALBATROSS AND YOUNG. A bird of this size can have such a large wingspread because its "elbows" project so far back. The Wandering Albatross reaches 10 or 11 feet from tip to tip



**BLACK-FOOTED ALBATROSS** coming in from the ocean to land on Sand Island, at Midway. In stormy weather, the hardy seafarer may tumble head over heels as soon as its feet touch



thing that it has seen, but it soon overtakes the ship and follows as before. Apparently tiring after a while of such an easy life, yet still showing almost no perceptible movement of its wings, it sweeps downward on one side of the vessel to within a few feet above the waves. Banking sharply, it clears one of them and descends into the trough before the oncoming wave, until the tip of one wing barely touches the water. Then, just as the observer imagines that the bird must surely be caught by the advancing wave, the huge pinions, still rigidly outstretched, slowly resume the horizontal position, and the albatross is lifted, apparently by the air forced upward by the

heaving water, until it is carried, still with wings rigidly extended, over the crest of the wave. This amazing feat is perhaps repeated a time or two. Then, without apparent effort, the bird glides upward and forward in a sweeping half-circle before the bow of the ship and, continuing downward at a greatly increased speed, passes the vessel on the other side and rises again to its chosen position at the stern.

It seems likely that these birds are first attracted to a ship through curiosity, but on approaching it they soon find that the motion of the vessel creates air currents that will help support them on their continued search for food. The

habit of following ships is not, however, common to all albatrosses. In the North Pacific it is usually the Black-footed Albatross that does it.

It has been said, with very good reason, that an albatross in flight looks unlike all other birds. It is also true that the wings are unique in that their extra length is acquired by prolongation of the first and second parts of the wing, the upper arm and the forearm. The flight feathers, in turn, are much shorter than one might expect in such a remarkably long wing. In other long-winged birds such as the swifts, swallows, terns, and frigate birds, the reverse is the case. There the flight feathers contribute a very great deal more to the length of the wing, while the upper arm and forearm are much shorter. The presence of the bones throughout a far greater part of the albatross's wing gives it much greater rigidity. This rigidity and the long and narrow shape of the wing make it much more similar, both in appearance and function, to the wing of an airplane or sailplane.

This peculiarity of the albatross's wing may be detected in many photographs of the bird in flight. The elbow and wrist joints clearly show as prominences on the front edge of the wing. When the bird is standing with its wings closed, the elbows extend so far back that



they often show as angular projections on each side of the rump. These features are clearly shown in the accompanying photographs of the Black-footed Albatross.

Although very graceful when launched in the air, an albatross appears ungainly and sluggish on the ground. When taking off, it has to have a head wind and must run a considerable distance before attaining sufficient speed to rise from the ground. Once it is launched, however, very few strokes of the wings are required to gain speed and altitude.

At Midway the Laysan and Black-footed Albatrosses made regular use of the road clearings and the sloping sand beaches for taking off. Coming in for a landing in stormy weather was always hazardous, and many birds were seen to tumble over as soon as their feet touched the loose sand. But the real danger was for those unfortunate individuals who were caught by the unsteady wind as they glided in at reduced speed and were blown into one of the clumps of *Scaevola* bushes with which the beach was lined. The bird was often left hanging by its half-closed wings among the branches, quite unable to free itself. It was not un-

common to find a bird in that predicament, but it was easy to release it if aid had not come too late.

When walking between the clumps of bushes near the beach in stormy weather, we not infrequently met an albatross as it swept around the bushes only a few feet from the ground to make a landing. On two or three occasions I just avoided having one collide with me. One man, while walking with two others, was hit in the chest and nearly knocked off his feet in this way. The bird fell in a confused heap on the sand, but after struggling to its feet and taking a few seconds to recover from the shock, it continued its way on foot, kicking the sand up at every stride and running with its wings half spread, apparently not seriously injured.

That the birds should take such chances when coming in from the ocean need not surprise one. No doubt they have been flying in to the islands in the same manner ever since they first frequented them, without the risk, until quite recently, of meeting and having to avoid any moving object taller than a bird of their own kind. It must be much easier for one of them to glide over the head of another al-

batross walking on the ground than to miss a man who might suddenly appear in its track.

Thirteen different species of albatrosses are generally recognized. Of these, nine fly over the waters of the southern oceans from about 25 degrees S. to the Antarctic Circle. These have their breeding grounds on various solitary and remote islands lying between 30 degrees S. and 55 degrees S. In most cases the islands are far from human habitation and from regular trade routes. Some of the more notable are the Auckland Islands, Chatham Islands, and Campbell Island, in the South Pacific; Tristan da Cunha and Gough Island in the South Atlantic; and Kerguelen Island and Crozet Islands in the Indian Ocean.

Of the remaining four species, one, the only species confined to the tropics, has its breeding ground in the Galápagos Islands. The other three nest on various small islands in the western part of the Pacific, between the equator and about 30 degrees N.

When one marks on a map of the world all the places where albatrosses are known to breed, one cannot fail to be impressed by their apparent love of freedom. It is as though these magnificent birds had retreated before the advance of navigation. It has always been the larger birds that have had most cause to fear the arrival of man, with the dogs, rats, and other enemies that generally accompany him.

It appears probable that the conditions existing on all the oceans between the latitudes of 60 degrees N. and 60 degrees S. might meet the requirements of life for the albatross, whose food consists mainly of squids and other forms of animal life picked up from the surface of the water. It is therefore significant that all the ocean areas that have been used most for navigation through history are entirely without any breeding albatrosses. These include the entire North Atlantic,

◀ LAYSAN ALBATROSSES on Eastern Island, Midway. Only in the Western Pacific or near the Galápagos are you likely to see an albatross north of the equator





► THE UPWARD CURVE of the flight feathers near the end of the wing is only seen during a vigorous down stroke or when the bird is soaring in stormy weather, as shown here



the northern part of the Indian Ocean, and the seas extending from there to, and including, all the part of the Pacific Ocean that is most thickly studded with inhabited islands. At the same time, the Galápagos Islands, some of the more recently discovered small islands of the Hawaiian chain, and other comparatively insignificant islands between Hawaii and the Asiatic mainland, little frequented by man, still have flourishing breeding colonies of albatrosses.

It is difficult to account for the absence of their nesting colonies from a great area in the southwestern part of the Pacific by any other reason than man's presence. This seems true even if we assume that these birds may have originated in the southern hemisphere and been guided more toward the eastern part of the Pacific Ocean than the western part by the prevailing winds that sweep northward with the Humboldt Current.

Since the occupation in recent years of some of the small islands

in the North Pacific, albatrosses have been greatly reduced in numbers by the interference of man. But happily several of the small islands of the Hawaiian chain on which the Laysan Albatross and the Black-footed Albatross breed were set aside by President Theodore Roosevelt in 1909 to form the Hawaiian Islands Bird Reservation, ensuring the survival of those two species. Less fortunate has been the third and largest species of these fine birds in the North Pacific, the Short-tailed Albatross. It had its breeding grounds only on the Bonin Islands and other small islands ly-

ing to the southeast. This bird appears to have almost disappeared in recent years. It is now seldom seen flying over waters where it was formerly quite plentiful.

The present status of the largest of oceanic birds of the North Pacific illustrates the importance of giving due consideration to the conservation of rare members of the local fauna whenever innovations altering the character of the environment are contemplated. Especially is their welfare a worthy cause when the creatures have economic or aesthetic value and are without harmful habits.



#### North Pacific

- *D. nigripes* (Black-footed Albatross)
- *D. albatrus* (Short-tailed or Steller's Albatross)
- *Diomedea immutabilis* (Laysan Albatross)

#### Galapagos Island

- *Diomedea irrorata* (Galapagos Albatross)

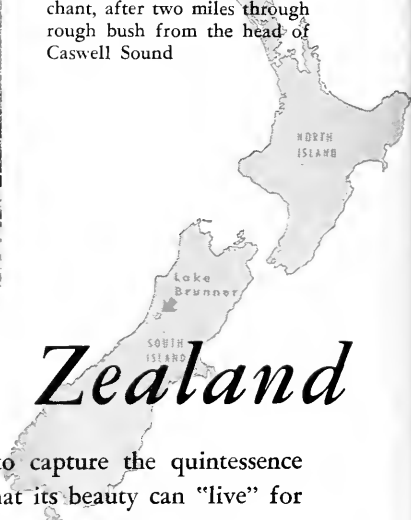
#### Nine Species in Southern Oceans

- *Diomedea exulans* (Wandering Albatross)
- *D. epomaphora* (Royal Albatross)
- △ *D. cauta* (White-capped Albatross)
- ▲ *D. bulleri* (Buller's Albatross)

- *D. chlororhynchus* (Yellow-nosed Albatross)
- *D. chrysastoma* (Gray-headed Albatross)
- *D. melanophris* (Black browed Albatross)
- × *Phoebastria fusca* (Sooty Albatross)
- + *P. palpebrata* (Light-mantled Sooty Albatross)



◀ MANY BEAUTIFUL LAKES adorn New Zealand. Here the author sits beside Lake MarCHANT, after two miles through rough bush from the head of Caswell Sound



# Discovering New Zealand

THE two places chosen for collecting the materials for our New Zealand exhibits for the American Museum's Whitney Hall of Pacific Bird Life had exactly one point in common. They were both known for their dreadful weather. The sub-Antarctic islands called the Snares, swept by gales and rain, were severe, majestic, gorgeous, and exciting in their harsh beauty, cold and uncomfortable to live on. Lake Brunner on South Island was also swept by almost steady rain. But it was a different proposition—a beautiful and charming spot, fascinating in infinite variety, comparatively comfortable.

The notes I made between the Snares trip, which ended December 6, 1947, and the Lake Brunner work, which began January 23, 1948, bristle with descriptions of New Zealand botany. We saw strange and wondrous things, what with daisies and fuschias growing all over large trees, and young trees changing their whole appearance before becoming adult. For the first time in my life I felt neck and neck with Bob\* outdoors. He knew little more of New Zealand plants than I did. In fact, when I played Eve and named the things I liked, I would actually find those very names in my noted naturalist's notes!

An expedition seeks to capture the quintessence of a remote land so that its beauty can "live" for Museum visitors some 9000 miles away

By GRACE E. BARSTOW MURPHY

All photographs by ROBERT CUSHMAN MURPHY

These botanical problems were as upside down as the seasons. I gradually learned to think of December as late spring and January as full summer. But reaching high over my head to pick a daisy, and learning how kauris and lancewoods transfigure themselves when they grow up, were ever new experiences.

We could not have worked up the Lake Brunner Exhibit without the several weeks of orientation given us before the work started—time for knowledge to be won and to mellow into familiarity. The complicated, isolated flora that developed through the ages, with scores of kinds of plants, gradually fell into its pattern. We had been sent by the generous New Zealand Government, or taken by kindly friends, all over South Island. We had been set down in every type of bush and had marveled at every type of landscape from wildest, somber Alpine scenery to wind-swept pastures, and coast lines where headlands embraced sandy

beaches. We had seen other lakes enclosed by snow-capped mountains and had picnicked among beech trees beside rushing brooks. When we finally reached Lake Brunner, we were at least partially educated in New Zealand out-of-doors.

There were five of us, in working clothes, setting off together in the pouring rain that summer morning: Bob Murphy, of course; Dr. Robert A. Falla, who was the other Bob of the Sub-Antarctic Expedition†; our two assistants, Ronald Balham and Baughan Wisely; and I. The job of another museum exhibit, in all its details, loomed ahead as a big one. There could be no coming back half around the world, so mistakes were out. Bob Murphy looked as though he had something on his mind.

The lumber launch, "Tikinui," makes a tour of Lake Brunner every morning. As we boarded her, a white heron sat on a treetop

\* Robert Cushman Murphy, Chairman of the Bird Department, American Museum.

† See NATURAL HISTORY Magazine: October, November, December, 1948.



▲ THE LUMBER CAMP at Hohonu, on Lake Brunner, where the expedition lived while collecting the New Zealand exhibit for the Whitney Hall of the American Museum

across the cove. It was the only explorer from the only heronry in New Zealand, at Okarito, 150 miles away.

The rain hid the mountains and made even the near shore misty. Yet we saw at once what a typical picture of primitive New Zealand nature this perfect choice would give. Tall flax lined the lake shore above small beaches. Rimu, the red pine that always looks like green waterfalls, towered above. The bush behind gave promise of containing everything we wanted.

Bob Falla had already tried to draw a general plan of the exhibit as he and Bob Murphy had imagined it. Bob Falla and I could not see how everything could be fitted into the eight- by ten-foot space allotted. It seemed to me that the whole Museum would be needed to suggest adequately how New Zealand looks and what lives and grows there. There is magic in the skill that can create a representative exhibit out of such quantities of material. Somehow Bob Murphy took it home in camera and packing boxes, notes, and paints. From now on, we will have New Zealand in New York. Will the hordes who look realize the Chinese puzzle confronting the expert who collected, planned, evolved such an exhibit—the sum in artistic form and in scientific detail of our lake, our bush, the mountain range we loved at sight?

DISCOVERING NEW ZEALAND



▲ NEW ZEALAND FLAX at Lake Brunner. Its beauty enhances every landscape. It was the source of most Maori textiles and is still important industrially

The flax by the water's edge, in eight-foot spears with longer flower stalks now gone to seed; the matai with its mossy, ferny trunks, and slender perching lily leaves growing from its high, gray-lichened branches; the great rimu with its look of falling waters, must all be shown at home. No picture of New Zealand could be complete without red-flowering rata trees, always in bloom somewhere; a fuschia tree, all over purple blossoms; the poisonous, shiny tutu, generally low-

growing; the manuka whose ghostly mist of flowers had passed; the plumes of toetoe; the miromiki, the lovely towai, a host of others, and, of course, the ferns. For of everything that grows in all New Zealand, the ferns make their way into one's very soul. High-towering tree

▼ A GNARLED OLD TOTARA supporting many "air plants," or epiphytes, overhung Lake Brunner's almost uninhabited shore. The totara, related to the yew, is usually tall and straight. The Maoris used it for canoes and carvings





▲ THE KIEKIE (*Freycinetia*) sometimes almost completely covers large trees in the bush with its graceful, slender leaves. It is a climbing member of the screw pine or pandanus family

ferns, of which there are a dozen varieties, ground ferns with six- to eight-foot fronds of a score or more kinds, tiny, filmy ferns on branches, swathe every spot. Yet even as one dreams of ferns, the trees flood back insistently into one's thought. The whole growth must be taken home if one would give New Zealand.

"Tikinui" struggled on across the lake to the lumber camp of eight to ten small weather-beaten cabins. Great rimu logs lay on skids along the beach ready to be tugged to the mill back at Te Kinga. Their huge size made me think of Douglas fir on the Olympic Peninsula in the State of Washington.

A small, tightly built cabin had

been assigned to us. We five hurried to it out of the rain. Ronald and Baughan had a big fire going in no time, and we hung our wet coats high on nails. We found one stool and four boxes to sit down on near the fire, but we were allowed little time for sitting. At 9:30 in the morning, we were called to tea served with sandwiches and cake. New Zealanders eat good food at least six times a day—seven, if one counts early tea in bed.

Rain fell heavily but did not stop our reconnoitering. It was a matchless spot! Everything we wanted seemed to grow there at its best, except red ferns and fuschia blossoms. I had set my heart on both

of these for our exhibit. On the western seacoast, 25 miles away, red ferns had enchanted me. I was bound to bring all of you red ferns. I hunted everywhere in vain, feeling that as long as such remarkable things existed, our Museum should tell our part of the world about them. We could not put one in our exhibit unless we found it in the section of the country we were bringing home. Every time I had a chance, I hunted for red ferns.

And all of us were hunting for fuschia blossoms. Bob Falla had said it was too late to find them in the midsummer month of January. I was most unhappy. But one day Ron dived into camp carrying a branch with one belated blossom. It meant that everyone at home could look at fuschias growing on a tree.

Our first walk took us along the beach, with its little, lapping waves. It was a striped beach of about fourteen narrow but definite bands of pebbles, sand, and driftwood, each band slightly undulating. It was a very pretty thing, an ingenious beach. Its pattern continued almost unbroken for a mile to the point of sand which marks the exhibit's center.

The edge of the forest was trimmed with flat, small-leaved cover plants. There were lichens everywhere, on stump and branch—apple green, dull green, bright green with red spores, yellow, orange. The mosses were varicolored, too, but not so gay as the lichens.

Toward the end of that first survey, walking down the beach, looking into the tangled, beautiful darkness of the bush, I saw Bob Murphy relax. In fact, he almost smiled, no doubt realizing that in spite of heavy toil ahead, the wealth he saw was what he wanted.

He portioned out the work. Baughan was to paint in water color each specimen as it came in. Ron was to gather material and press the plants. My job was to sew up specimens both for drying and for the formalin cans, to collect, and to help wherever I could. Because a mere wife is that necessary

release of tension, a steam exhaust, I knew that offers or lack of offers to help were equally risky. The kind of collecting we were doing was indeed nervous work.

So I had my notes and pencil, or my book, in hand and succeeded pretty well, I think, in being either invisible or on the jump to help at whatever came my way. And I could always hunt again for that red fern I craved.

"Saw off that dead limb with all its growth intact," Bob called to Ron.

"Do you want this big piece of bark all over moss and ferns?" I asked.

"Yes, it's a good one. Put it in."

We hardly stopped that first day except to eat the good "cut lunch" brought from Moana. Before the warm, bright fire, we had a whole stuffed squab apiece, tomatoes fresh from somebody's garden, big sandwiches thick with butter, cake and tea.

Bob photographed and even began to speak again as the job

shaped up in his mind. The clouds lifted, and he photographed the half-exposed mountains which rose in cadence like a melody far across the lake. He needed pictures of every kind of sky to choose from for the final designing.

I took a chilly swim. "Tikinui" returned. We left Baughan sketching the rosy leaves of the pepper bush, and Ron bringing in armloads of specimens. The two Bobs and I went back that first night to the pleasant inn at Moana. But commuting ended then. Mr. and Mrs.

Watson at the lumber camp called Hohonu, gave up their own room to us in their little home.

The sweet smell of a summer morning greeted us as we started back to camp the second day. Bob Falla had returned to Christchurch. Big crates of supplies for our work had come and were loaded on the barge. They contained cans of formalin, 50 pounds of newspapers for packing, tools, jars, burlap bags, excelsior, and various other equipment for moving a cross section of lush virgin land 11,000 miles. A



▲ THESE conspicuous nursery nests of a New Zealand spider (*Dolomedes*) are often filled with hundreds of tiny spiders



▼ TOETOE, which resembles pampas grass, belongs to the genus *Arundo* and grows only in New Zealand. Its swaying golden tassels are wonderfully beautiful



▲ PROFESSOR LANCE MCCASKILL, of Lincoln College, is giving the newly-arrived American an early lesson in local botany. Mrs. Falla, Mrs. McCaskill, and Margery McCaskill listen in





▲ A NATIVE SPECIES of scaup duck which the New Zealanders call "black teal." There are many families like this in various waterways

➤ GRAY DUCKS, the commonest of the waterfowl, are at home in town or country throughout New Zealand



▼ RONALD BALHAM, of the New Zealand Fish and Wildlife Service, was a member of the party at Lake Brunner. In this picture, he is trapping and banding gray ducks to learn more about their dispersal



trunk contained preparator's equipment, photographic supplies, plaster for molds, and so on.

As the launch neared the shore I thought of how the tree line graphically interpreted the two so different exhibits my husband was bringing home. At the Snares, the roof of the only kind of tree is an even, uninterrupted line, with no tree taller than another and no branch exposed. The look of that even matting was as harsh as the feeling on one's fingers of the stiff, thick leaves. It gave an austerity to the landscape which the nervous evening flight of the millions of muttonbirds accentuated. At Lake Brunner all was warmth and wel-

come. Each tree grew in its individual way, not only in a great variety of kinds but also in a great variety of individual trees of each kind. At the Snares, we were cold and harried by discomfort. At Lake Brunner, I would sit in the shade of a fuchsia tree beside the lake opposite the beautiful mountains. Near me, the collections were being completed in a suitable workshop. A stone's throw away stood the cottage to which Mrs. Watson cheerily called us to good, warm meals served in comfort.

When we first reached New Zealand we were constantly aware of the comparative lack of roadside flowers. I heard that there are some

in early spring on North Island, but we saw almost none. Imported fox-glove does not suit the landscape. What wild flowers there are largely consist of what I called "carpet flowers," a name everyone took up. They spread, flat to the ground, over large areas, pink or purple, yellow or white. We needed some in the exhibit. As the bush was heavy, they were hard to find.

I walked up the narrow logging rail track and, in searching, found two in a tree-denuded place. One was a tiny white asymmetrical one I knew. Its fine petals grow in two-thirds of a circle. The other was a still smaller, flatter plant, gone into cerise berries. With the white paperish one on the beach top, we had three kinds, which may sound dull and little, yet they had seemed an important part of New Zealand vegetation.

Baughan made line drawings of them as he does of all the plants, filling in with color. Mrs. Watson had opened another cabin for him so that he could work in comfort at a big table. Ron pressed my little plants. He had been pressing small white orchids when I came in. These grew high up on the older trees, leaves hanging down in slender curvings.

Bob handed me the specimens he was sewing into bags and worked on making bird skins. When made up, they are stuffed with excelsior and packed in cotton for their long trip.



Bob was, of course, everywhere at once, feeling faith in his assistants and contentment in the work. He made use of every scrap of sunshine by taking Kodachrome shots of scenery, plant associations, and detailed plant studies, such as a row of branches showing the development of lancewood.

Big boughs were nailed into the crates. We sometimes tied on leaf clusters in veils of cheesecloth. Yet even when leaves wither and fall off, their shape and size and habits can be figured out by men used to doing it.

After our first supper at Hohonu, Bob said, "Come on up the beach. I want to make a sketch of the plan for the Group."

We sat on a log, the beach in front of us, the forest behind, and the mountains rising out of the far shore four miles or so away. It seemed at first that to concentrate everything into a Group's small space, some shifting must be done. First we suggested moving the mountains, and then we suggested moving the lake. His design gradually came into being with the whole forest and forest floor, lush with growth, at the left, melting into a background of painted trees. Nothing was moved, except that the point was turned a little to run into the lake toward the right, leaving space for the moa we were to dig up the following week. The lake beyond the point merged into the background that Lee Jaques was to paint, with its mountain range exactly like the view in front of us. With the moa on the beach, ducks of several kinds and black teal in the water, tuis eating fuschia berries, a fantail flirting from a rata, a kiwi peering out from flax, and pigeons, tits, and others, we both felt content.

Bob later cut a small-sized tree fern. He photographed it from above to show the pattern of the fronds and heart. The fronds were cut off, measured, pressed in sections. Fresh fronds were preserved in formalin. The trunk was cut in two and tied up in a sack ready for boxing. Even old brown fronds, which fall like skirts around the up-



▲ THE SUPPLEJACK grows every which way and is the toughest, woodiest, and most luxuriant of the lianas. The Maoris aptly named it tataramoa, which means "trip up the moa." It also trips up people

per trunk, were packed to go. Bob catalogued and tagged each specimen. Baughan edged all his sketches with notations. Ron changed the papers in his press each day and dried out the papers before the roaring fire. I sometimes helped him. He is taking extra care of lichens and mosses—a typical feature of New Zealand rain forest. Heavy rain often made indoor work hard because of little light. Yet Ron unwound his tightly rolled newspapers over each specimen with infinite care, so that leaf and frond and flower were perfect, all moisture gone. One of our special treasures—some bright blue toadstools—were sewed up in cheesecloth and dropped into formalin.

Bob and I talked constantly of specimens we wanted. The list would grow shorter only to lengthen again as we added new discoveries. We collected tall, hard bracken. The lawyer vine, so named because when it gets its fingers on you, you can't escape, hangs over many shrubs and trees in deceitful daintiness. Unlike most vines, it grows upward on other stems or trunks and falls backward on the outside of its host.

Three women lived all year round at Hohonu, completely isolated yet cheerful—lovely women, with that good breeding and sensitiveness

toward others that seems to be inherent in all New Zealanders, no matter what their station in life. Mrs. Watson took me up the logging track for tea with Mrs. Hall. We had buttered scones, cookies, cakes, far more than I could eat. As we went outdoors, a commotion bubbled at the door. Someone called: "A stoat!" I saw the family cat pounce under the house. It caught the frightened animal, which I brought to Bob in a jar. It is now in New York. For stoats must be killed. They are one of the imported pests that have injured the beautiful pristine New Zealand wildlife.

That same afternoon Mrs. Watson and I decided on a wider jaunt to hunt for my red fern. A high point, heavily bushed, juts far into the lake on the other side of our camp from the beach. One of the men took us in the small launch around the peninsula so that we could walk back through it over the rough track. The boat had hardly touched shore when I saw my lost love on a cut bank and, shouting its name, I dropped on my knees in front of:

#### THE RED FERN!

It was a little one but very red. Larger ones were found later.

We scrambled over roots and fallen logs and up and down in gullies. Many crowns of golden ferns glowed like lamps throughout

the dusk-filled forest. It was a very bushy bush—a jungle with a vengeance. It was hung with lianas called supplejack, doubled up in knots and curves and twists. Everything was covered with something else growing on it. The rata vine, related to the crimson-flowering tree that also starts life as a vine, was very thick. It, with ferns and lichens and great long clumps of leaves of lilies, tangled the forest floor and all the space above. The trees were mostly totara and rimu and what the country people call birch.

When I spoke of birds, Mrs. Watson said, "There are very few birds here."

"Do you know why?" I asked.

She did not, and I told her the tragic story of New Zealand wildlife. The country had, in its isolation, developed a balance of nature in which there were no mammals at all except two small bats. The bird life was not only prolific, beautiful, and unique, but it was also adjusted to the absence of predatory beasts. When the pioneers came, they introduced all sorts of animals: deer, rabbits, hedgehogs, weasels, and, of course, rats. These, having no enemies, ran riot. The birds were wiped out almost to extinction. Now the Government and an aroused public interest are protecting what are left. But the dearth of birds is tragic. Our Museum expedition was allowed to collect *one* tui, *one* pigeon, and so on, as each individual bird is now guarded as far as is possible.

Mr. Watson, Mr. Hall, and four of the men took me on the logging tractor several miles into the hills. As we ascended above the lake, the lianas disappeared and the forest was more open, with rata and rimu predominating, and a thick undergrowth of coprosma and fern. Tree ferns were left behind as we climbed. I was happy to see a stand of the dainty umbrella fern and more red ferns. These, by the way, turn green when adult.

The rough, narrow-gauge tracks were laid on crude trestles over rivers and small gulches. As we went deeper into the bush, they

were built on heavy ties laid across the same sized rimu logs brought down to go to the mill: 40 feet long, 18 inches or more thick. Heavy mist soaked through everything as we sat on the car edge swinging our feet, our knees brushed with wet bracken and sedge found in the areas devastated by earlier logging. High up above the lake, we were surrounded by great, straight trees. Only those with 2000 to 2500 board feet were being cut. It was freehold land, with no government supervision. Mr. Hall gashed the trees that were doomed—great beauties with hundreds of years of growth. The men felled them with a double-handed saw. With a system of cables, the donkey engine lifted the heavy logs, pulling them to the tracks and swinging them into place on the

open cars, which were adjustable in length to fit the logs.

The waste of wood was terrible: all the branches, all the bark, and great stumps. Huge logs lay everywhere, unused and blackened. There would be no paper shortage were this wastage used. Enough fuel to warm a city lay about us. I had already seen how much wood was lost in the sawing process at the mill across the lake. I have seen it just as bad at home.

As we with our heavy load of logs rushed down steep grades, Mrs. Hall flagged us and gave me a load of ferns and branches she had gathered for us. She had found ferns we had not seen, and fungus, too. How could a woman who had never seen a museum like ours know our needs? Yet all our lives I've noticed that wherever Bob col-



▲ PRIMEVAL BUSH at Lake Brunner. The branches of the matai, or black pine, are heaped two feet deep with mosses, ferns, orchids, and other epiphytes

lects, everyone else sets to collecting, also. One of the men brought him a green lizard, a gecko.

We had a wild time getting off that afternoon, packing and nailing the crates. The work was not finished, so after a week of digging moas at Pyramid Valley, Bob and I returned to Lake Brunner by ourselves. There's a little rail car that runs at night from Christchurch on the narrow-gauged tracks standard in New Zealand. It is designed to ensure perfect wakefulness.

As we stepped off at 6 A.M., a spot of gold came over the hills, and the whole gold ball followed so brilliantly one could not face it. The line of hills and all the world seemed to move toward it. A sweet-faced woman stood at the door of the small hotel, saying that early tea was ready for us. "I can't leave all this," I said.

She understood and brought the tray outdoors.

Instead of sunrise colors, shining light on ridges and purple shadows in the valleys made a different beauty. The sun had to travel high before topping the mountains and shining on the town. First it wasn't there, and then it was. We had hardly dared hope for the perfect day that dawned for us in that so

rainy country. As we crossed the lake, every peak and every marking on each slope stood clear and sharp. The men stopped "Tikinui's" engine for camera studies of snow mountains.

Landing at Hohonu, sitting in front of the clear blue lake beneath the forested mountains, it seemed the most beautiful spot in all the world. After the mist and rain and hidden distance of our first visit, the clarity and warmth and smooth sun-dancing water seemed incredible.

We rowed to the sandy point and landed on an equally sandy island. Red deer had left their tracks for us. A pied oyster catcher flew above us. Some far-off birds swam in the lake. Up the dark river, sunlight, reflected from the water, ran down the flax leaves like a play of intermittent light in electric signs on Broadway. Manuka, of tiny leaves, swayed gracefully in the wind.

"You row down while I take pictures," said Bob, handing me the heavy, hand-hewn rimu oars.

Though I had brought my bathing suit, there was no time for swimming. Frivolities are not included in museum expeditions, nor are 40-hour weeks ever known to naturalists.

Later, we rowed in the other direction, around the high, heavily forested peninsula, Bob's gun and camera loaded.

"Watch for teal," said Bob.

"There are gray ducks."

"I don't want those, only black teal."

Bellbirds were calling from the forest. A great darning needle with enormous eyes lighted on the stock of Bob's gun. Others mated on the wing. We beached on white stones. A black shag skimmed the water, yet there were few birds for such a wilderness.

A tui flew by, its white lace-shawl shoulder feathers showing against its dark iridescence. Great logs lay half submerged, a graveyard of trees. An eel lay on the stones in clear, deep water. Bushy trees, covered with red flowers, showed at the edge of the forest.

"That can't be rata," said I.

"No, it is kamahi," said Bob. "I'm going to break through to the track and take Kodachromes of yellow ferns."

I started to get out of the boat but fell asleep in a lump instead, after the night we had had on the rail car. Waking with the sun in my eyes, I waded ashore to explore while Bob was gone. Probably few people had ever been there before. After many months, I still see the graceful sedge growing from white stones, and the growth of all kinds, now so familiar and so dearly loved. Detailed study such as we had made—such as all naturalists always make—rewards in detailed memory of beauty.

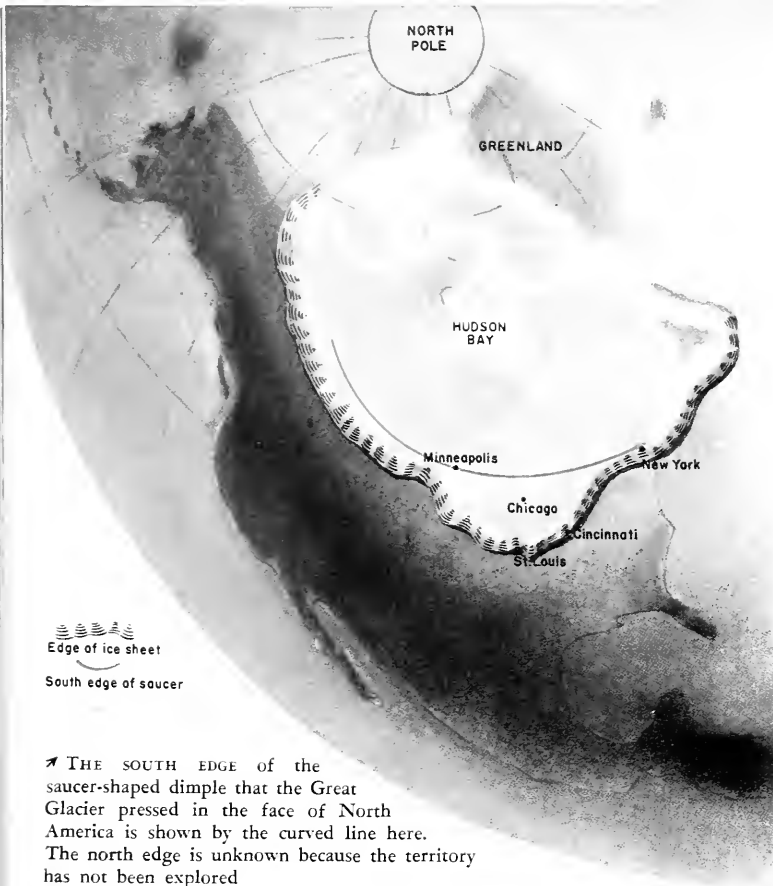
One always makes discoveries. A very fragrant white orchid grew on low branches of host trees. It is called *autumnalis* because of its late flowering. White violet-like flowers grew with daisylike ones, all tiny, on the stones. Three fantails played about us in the trees—small flirting birds who want to know what's happening.

As we rowed back against a heavy wind, we at last found the clay we needed for the essential leaf molds, in the corner of the beach by the peninsula. Bob sliced off pieces into a basin, and we hur-

*Continued on page 192*

▲ THE TWO MILES of beautiful but heavy bush between Caswell Sound and Lake Marchant were hard going





Once the Great Lakes poured south through what is now Chicago, and they may do so again. The broad dent left by the weight of the Great Glacier is rising, and even Hudson Bay may someday be high and dry

By

RICHARD FOSTER FLINT

*Professor of Geology, Yale University*

## UPS and

THE water surfaces of the Great Lakes rise and fall irregularly by as much as three feet. This does not seem like a large amount; yet in the harbors and the ship channels through which the tremendous commerce of the lakes is conducted, three feet may make all the difference between safe clearances and the huge costs of dredging the bottom.

In 1900, the city of Chicago completed a canal connecting Lake Michigan with the Mississippi River basin. The canal allowed a small part of the lake to escape southward toward the Gulf of Mexico, whereas all of the overflow had formerly passed over Niagara Falls. Years later the lake level began to fall, to the detriment of installations at many points along its shores. The city of Chicago was sued on the ground that its canal had caused the trouble.

While the U. S. Supreme Court was considering the case, the lake level rose again, proving the city's innocence; and as if to reinforce the proof, high-water storm waves damaged shore property to the extent of millions of dollars.

Besides proving that you can't please everybody, these rises and falls of water level bring up the interesting question of their cause. Probably it lies in long-term changes in the weather over the Great Lakes region as a whole. But whether the changes result from this or from something quite different, the water fluctuations have focused attention on far greater changes in all the Lakes—changes that have been going on for many thousands of years. For this world's mightiest group of fresh-water bodies has had a startling history, the record of which is written plainly in the Midwest landscape.

The story of how the events in that history have been learned and arranged in their proper order is a fascinating example of how natural science goes to work.

### Ancient Beaches

To most travelers between Great Lakes cities and the East, the steep bluffs, beaches, and hummocky yellow dunes that mark the shores of the lakes are a common sight. Away from the immediate shores, many a tourist with an eye for landscape sees similar things along his route. The highway he travels follows a low ridge for ten or twenty miles. Here and there the ridge is replaced by a steep, grassy bluff. The ridge looks like a beach, and the bluffs like long, low headlands cut by the waves. Patches of knobby terrain suggest dunes, although instead of showing yellow sand they are covered with

grass. And in front of the bluffs, instead of blue lake water there is mile after mile of nearly level ground, its rich black loam showing in plowed fields that stretch away to the shore of Ontario or Erie or one of the other Great Lakes.

Such an assemblage of ridges, bluffs, and plains can only mean that the lake shore once stood here. It was abandoned long enough ago to permit vegetation to heal the steep cuts made by waves and to clothe bare wind-blown sand with grass. Yet the lake receded so recently that the washing of rain water and the slow creeping of the soil have done little to dim the original sharp outlines. Among the cities situated on former shore lines or on former lake floors are Chicago, Detroit, Toledo, Cleveland, Buffalo, Toronto, Saginaw, and Superior. All these cities occupy ground formerly under water, and all have some streets or roads built on broadly curving beaches or bars.

tions of the old shores, both on the American and Canadian side. All recognized what they were, but none guessed why the lakes had abandoned them. The right guess was not made until much later.

#### **Dry Rivers**

Gradually, the outlets of the former lakes were discovered. These outlets are the beds of great rivers, dead and abandoned like the shores that curve into them. The dry river beds lead away from the lakes toward the ocean, just as the St. Lawrence River leads away from Lake Ontario today. One of these old river beds, nearly a mile in width, begins on the western outskirts of Chicago and is the low-level line along which that city dug its canal in 1900. Another leads eastward across New York State to the Hudson River; for a time it must have given to Manhattan much of the volume that Niagara has today. Still another old chan-

nel, 700 feet wide, leading across part of eastern Ontario, was cut 40 feet deep into a mass of earth, stones, and boulders left by a former glacier. But the channel now contains only the biggest boulders, left behind because they were too big for the outflowing river to move. Their huge size tells us that the river must have been a swirling torrent, for it carried away everything of smaller size.

The Great Lakes today are a single connected system with a single outlet, the St. Lawrence River. The abandoned outlet channels seen along the high and dry old shores suggest that the Great Lakes basin as a whole is roughly like a very broad, very shallow, water-filled pan, with slight irregularities in its rim. A very little tilting of the pan makes the water spill over through any low place in the rim, in one direction or another. But the early naturalists kept thinking of the old shores as seashores.

# *Downs of the Great Lakes*

raised a few feet above the surrounding flats and affording ideal natural causeways. The combined area embraced by such features is more than half as great as the combined area of the Great Lakes today.

So conspicuous is this array of former shores, high and dry above all the present lakes, that they were noticed and reported more than 100 years ago, during the settlement of the Great Lakes country. Between 1830 and 1840, a good half-dozen geologists, engineers, and surveyors published descrip-

► WHEN THE ICE SHEET MELTED, a large part of Canada rose. Hudson Bay therefore shrank, leaving these beaches and bars to show where the sea once extended. They are comparable to the ones that can be seen well inland around the Great Lakes



*Photo Dept. of Mines and Resources, Canada*

made during some submergence of the land and later somehow lifted above sea level. One, W. W. Mather, writing in 1843, suggested that "The Gulf Stream caused a flow into Lakes Michigan and Erie from the Gulf of Mexico" and on across New York State into the Hudson Valley. This was a wrong deduction.

Such high-flown theorizing is all very well in the absence of many facts. But gradually more facts piled up, narrowing down the possibilities. It was found, first, that instead of having only one abandoned shore, each of the Great Lakes had many, one above another. Indeed, there are places in the Lake Huron basin where as many as five can be seen in a single view. Then it was discovered that in places the sand and soil in the old beaches and flats contained the fossil shells of clams and snails such as live in shallow lake waters today. From these facts it became apparent that the shores were those of lakes, not of the sea, and that the lakes had stood at several successive levels.

#### Barriers of Glacial Ice

Next it was found that although

the lowest, more recent shore lines run all the way around the lakes, the higher, older ones suddenly end toward the north and simply are not present around the northern sides of the basins. Meanwhile, it was discovered that wherever a gully or an artificial excavation cut through the beaches and lake-floor deposits, these deposits were built *on top of* the earth and stones left by the great glaciers during the Ice Age. This combination of facts showed that the lake shores were made *after* the glacial ice had melted. It suggested further that the reason there were no shore lines in the north was because there the lakes had washed against the glacier itself. In other words, each lake had a northern shore of ice, which subsequently melted and left no record of itself whatever.

While this picture of a huge system of former glacier-dammed lakes was becoming clear, an even more remarkable fact appeared. The shore lines were found to be not horizontal but tilted. The higher and older the shore line, the more steeply it is tilted. All of them rise toward the north. It is certainly surprising, at first sight, that the former shores are not "square with the world."

But it is not at all surprising that no one discovered the fact until 40 years after the shores themselves were first recognized. This is because no matter how hard you look at the beaches themselves you can't *see* the tilt. The amount is too small to be perceptible within the mile or so of distance that the eye can encompass in a single view. But although an inclination of 2 feet in a mile is too slight for the eye to observe, a beach having this inclination will rise 100 feet when followed northward for 50 miles. With longer distances the rise becomes more striking. A beach that is only 40 feet above Lake Michigan rises, as it is followed 130 miles north to Sault Ste. Marie, Ontario, to 400 feet above this level. Its average inclination between these points is 2 feet, 9 inches per mile.

Several decades of patient work with surveying instruments have resulted in fixing the positions and altitudes of most of the shore lines. The water surfaces of the present-day lakes are like gigantic spirit levels, for they form angles with the old shores that rise northward. As it is obvious that the old shores must have been level at the time they were made, something must

▼ AS THE LAND ROSE with the retreat of the glacier, seacoasts were also affected. Here an old beach, 100 feet above the present one, is visible continuously from

left to right. The broad step in the headland at the left was cut out of hard rock by storm waves when it lay at sea level. Trout River, Newfoundland





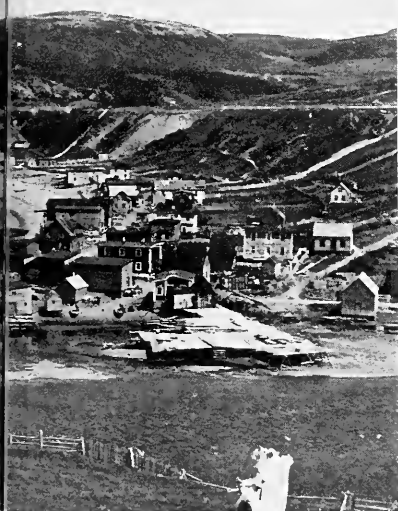
have deformed them since then.

The deformation is not confined to the Great Lakes. To the west, as far as the Great Plains of Canada, there are other tilted-up shores of former ice-dammed lakes. To the east, in New York and New England, there are more tilted-up lake shores. And along the Atlantic coast itself, through New England, the Maritime Provinces, Newfoundland, and Labrador, old shore lines made by the sea itself are tilted up. Some of them are terraces saved by breaking waves through hard bedrock, and many of them contain the fossil remains of marine animals. In eastern Canada some of these shore lines reach as far as 700 feet above sea level, and in their sands and clays have been found marine shellfish and the bones of whales and seals.

#### A Giant Bulge

Throughout this whole northeastern part of North America, the tilted shore lines fall into a definite pattern, in which there are two elements. The first is that the area of tilted shore lines coincides pretty closely with the area covered by the former great ice sheet. And the second is that the direction of up-tilting, regardless of the location of the shore line, is toward the

*Richard Foster Flint photo*



▲ THE GREAT LAKES were formerly much larger, as shown by the outer line. Niagara Falls has not always received their overflow. At various times since the retreat of the Glacier, the lakes emptied into the Gulf of Mexico, the Atlantic Ocean near New York City, and Hudson Bay

Hudson Bay region, which was the center of the ice sheet when it was thickest and most extensive. When we remember that the lakes did not exist until the ice had started to melt away, all this looks as though the tilting had been closely connected with the ice itself.

And so it was. Hudson Bay lies at the center of what was once a gigantic depression in the solid surface of the earth, a dimple with a diameter of 2000 miles. If it were not for all those shore lines, each of which was originally horizontal but is now bent upward toward Hudson Bay, we would not know that the dimple was ever there. When the massive ice sheet lay on the ground, its vast weight "pushed in" the earth's surface, and when the ice melted away, the pushed-in area—a broad saucer-like depression—was gradually erased as the ground bulged up toward its original position.

#### Rock that Flows

At first sight such a picture of flexible ground does not seem to make sense, for we can all see that the rock at the earth's surface is very brittle and quite unbendable. However, its brittleness is deceptive. We all know that the materials

we use in daily life bend before they break; why should not rock? Of course, it does. To produce the effect just described, each foot of rock only had to bend scarcely one-one hundredth of an inch, if indeed it did not break a little here and there. But what, you may ask, was going on underneath? A relatively short distance beneath the surface, the rock is not brittle at all but instead is weak and bendable. The weakness is the result of the tremendous pressure exerted upon the rock by the sheer weight of the rock that overlies it. The farther below the surface we go, the greater the pressure becomes. When it reaches something like 150,000 pounds per square inch, the rock has become so weak that a slight push in any direction will make it flow like dough or putty. In short, the rock is plastic. And it stays plastic only as long as it is under at least that much pressure—a pressure three times as great as the pressure inside a modern howitzer at the moment it is fired.

So the weight of the overlying rock—a layer many miles in thickness—keeps the rock down below in a plastic state, all ready to flow as soon as it is given an extra push. But we are dealing with things on

a big scale, and it takes something pretty large to provide the push. For that something a big ice sheet, 2000 miles in diameter and anywhere from 1000 to 10,000 feet in thickness, will do very nicely. Built of atmospheric moisture in the frozen form we call snow, an ice sheet constitutes an unusual and extra load on the earth's surface. A big ice sheet 5000 feet thick adds another 2000 pounds per square inch to the pressure beneath it. That is the extra push. Take a pound of margarine in one of those transparent bags that distribute the coloring matter through it. At ordinary temperatures the margarine is stiff and does not flow; it holds its shape. Now press your thumb slowly into the middle of the bag. The pressure of your thumb is the extra push necessary to make the stuff flow—away from your thumb where the pressure is greatest, toward other parts of the bag where the pressure is less. This is what happens to the plastic rock material many miles down when the ponderous glacial thumb presses upon it. The only difference is that when your thumb is removed, the margarine, being under no extra pressure, stays where it is; it does not "recover," whereas the deep earth substance, being still under pressure from all the rock on all sides of it, flows back again as the glacier melts.

It is evident, then, that the "bulge" that tilted the shore lines is not something new. It merely wiped out a broad dimple that was temporarily impressed in the face of the earth, bringing the surface back to where it was before. *Terra firma* is certainly a misnomer for the ground we walk on!

#### Putting the Story Together

Our tilted shore lines have got us into some pretty deep water, but with our picture of a margarine bag firmly in mind, let us try to reconstruct what occurred. First, with a chilling of the climate about 100,000 years ago, the winter snowdrifts failed to melt during the summer, and little by little the ac-

cumulating snow formed vast glaciers, one of which spread over the whole northeastern part of North America, reaching its greatest size about 60,000 years ago. As it spread, its great weight depressed the ground beneath it, until in places the ground had sagged as much as 2500 feet. This seems like a tremendous depth; yet when we recall that the radius of the sag was 1000 miles, its average slope could have been no more than  $2\frac{1}{2}$  feet per mile—too slight an inclination to be seen by the eye.

Then the ice began to melt. Along the coast the sea filled in areas as fast as they were vacated by the wasting glacier. Inland, water from the melting ice was caught between the edge of the glacier and the ground that sloped toward it. Around the lakes thus formed and along the sea, storm waves dashed against the shores and cut cliffs, and longshore currents built beaches and bars. As each lake basin filled with water, it overflowed, and thus were cut the great river channels, now dry, such as the one in which Chicago made its canal.

As the glacier melted and grew thinner, its weight upon the ground diminished and the vast saucer it had pressed for itself began to get smaller and shallower. In this process, the horizontal shore lines that wave and current had inscribed upon the land were slowly bent up toward the center of the saucer, where the wasting ice still lingered in the Hudson Bay region.

The change was a slow one. The lakes began to be formed about 35,000 years ago, and the unbending has been going on ever since—throughout a period more than 100 times greater than the time that has elapsed since the Pilgrims landed at Plymouth Rock. The ice disappeared from the center of the saucer perhaps less than 10,000 years ago, but the saucer is not fully erased yet. The determined upbending is still going on around Hudson Bay, creating a fantastic collection of abandoned shore lines in the process; and it still has 600 to 800 feet to go before the ice-

made depression will have been completely obliterated.

#### A Look into the Future

"Wait a minute," says someone. "Was that figure 600 to 800 feet? But how deep is Hudson Bay? Mostly less than 500 feet, isn't it? Well, then won't it . . .?" Quite true; it will become dry land. Moderately dry, at least, for all the rivers that now flow into it will gradually have to lengthen at their mouths until they join to form a single trunk stream with its outlet somewhere near the western end of Hudson Strait—or Hudson Inlet, as it will have to be called then. All this is going to make our present-day maps of North America quite obsolete, for our continent will have lost its one big inland sea.

The outermost parts of the great dimple seem to have been erased already, and in the Great Lakes region slow downbending toward the southwest is now going on. Whether this movement is connected with the ice sheet or has another cause is not known. But whatever the cause, the northern shores of Ontario, Huron, and Superior are nearly stable, whereas the southern shores of Superior, Michigan, and Erie are sinking at a rate of more than one inch every ten years! This movement is measured accurately by Government water-level gauges and is independent of the rise and fall of the water surface with which we began this story. Its effect is to deepen all southern harbors such as Chicago, Milwaukee, and Cleveland while leaving those in the north almost unchanged.

If this movement continues, it will have one remarkable consequence. Unless some kind of dam is built at Chicago, the sinking there will make Lake Michigan spill over once more and send its overflow into the Mississippi River. The small controlled overflow that already goes that way through the canal could in time grow into a really big river. Whatever water flows out past Chicago robs Niagara Falls of an equivalent amount; so there is plenty of material in the situation for a big legal argument.

# TO FIND *Wild Honey*

One hundred pounds of it in one tree!  
But the thrill of observing the marvelous  
creatures that make it may be richer  
reward than the golden treasure

By ARTHUR C. PARSONS

*Photographs by the author*



**H**AVE you ever seen a swarm of bees pass overhead on a warm day in the spring—a buzzing, humming swarm which resembles a rapidly moving smoke cloud that soon disappears into the distant forest? Or have you ever seen a swarm forming a dense cluster two or three feet long on the branch of a tree? Have you wondered where they came from and where they are going? Every beekeeper knows the answers, of course, but those questions were answered for me by the bees themselves some years ago.

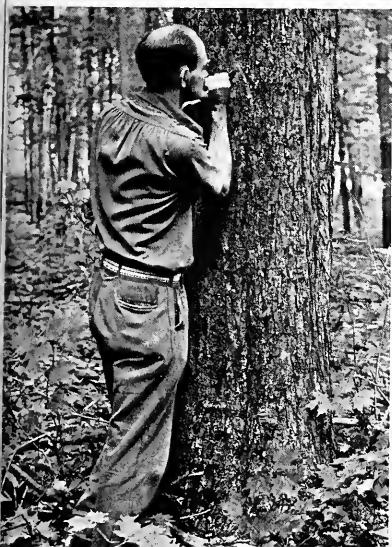
One warm afternoon in May, I was photographing some of the different types of ferns in a pasture when I noticed some honeybees coming and going through a small hole in a dead black cherry tree. The hole was only some four feet above the ground, so I was able to observe them easily. There were so few of them that it was obvious that no wild swarm occupied the tree as yet. Apparently they were merely exploring the possibilities of the tree as a new home; but at the same time, they were busily engaged in removing wood chips, sawdust, and other debris from the cavity. A few days later my assumption proved correct. A large swarm came from a gnarled old cherry tree about 500 yards away. This old tree had been occupied for about 20 years by a swarm of Italian bees that had escaped from an apiary in the neighborhood. Many people knew of this swarm and had wanted to cut down the tree to obtain the honey, but because it marked the boundary between two properties, the owners had refused

▲ **THIS BEE's** home is in a hollow tree near the heart of our nation's capital. But the serious hunter of wild honey will be lured into woodlands he might never have thought of visiting

permission. Now the swarm hovered in the air for some time and then settled on the limb of a nearby maple for about an hour. Taking flight, it headed in the direction of the tree in the pasture, and when I arrived about half an hour later there was a huge cluster of bees around the entrance to the hollow. They prospered there for five years before bee hunters found and cut the tree.

What prompted the bees to depart from their established home? When a beehive or bee tree becomes too crowded, when there is not enough space for the bees to store a sufficient amount of honey to sustain the colony through the winter months, the bees provide a new queen for themselves by constructing large, more or less cylindrical "royal cells." The grub that develops from the egg laid in such a cell is provided with "royal jelly," a special food secreted by the worker bees and fed to the bee that is to develop into a queen. When this new queen emerges, the old queen and part of the swarm

◀ **SPORTSMANSHIP** among honey hunters. The procedure is to carve one's initials in the bark so others will know that someone else discovered it first



leave their hive to seek a new home in a hollow tree or some cavity, leaving the old home to the new queen and the brood she will produce.

Preparing the new home for occupancy is no easy task. The explorers who found the hollow merely started the work. The hollow must be cleaned out thoroughly. All dust and chips must be removed, cracks must be sealed against the weather and possible enemies, and, most important of all, new comb must be made at once for brood and for storage of honey for the cold months to come.

To make the comb, the bees form a chain from the top of the cavity. Each worker has plates on the underside of her abdomen on which the wax forms. They scrape the wax off and use it to build the comb. So, in a few days, there are

cells in which the queen can deposit her eggs and in which the workers can store their honey. If the season is good, more comb will be built, for the bees never cease to work as long as there are flowers from which to gather nectar and space in which to store it. When the comb is first built, it is water-white in color. With age it becomes yellow and finally dark brown or black. The same comb is used year after year, but it does have to be repaired from time to time.

Hunting wild bees has been a popular autumn sport in some parts of the country ever since the colonists brought the first bees and permitted some of them to escape to the forests. Bee hunters seem to get the same thrill from locating a bee tree that hunters do from bringing down a ten-point buck or fishermen from landing a fighting

trout or bass. In many cases, too, a winter's supply of honey for sweetening has been the incentive for following the bees to their home in a hollow tree.

Several methods are used in locating the forest homes of wild bees, but probably the most popular is the use of the bee box. This is simply a wooden box approximately the size of a cigar box, fitted with a glass top that slides in grooves. A hole about one inch in diameter is made in one end, through which the bees can enter and leave. A slide is fashioned so that the hole may be closed if the hunter wishes to imprison the bees for a short time. An old piece of honeycomb about four by six inches completes the outfit. The bait to attract the bees is honey or sugar syrup, which is poured into the cells of the comb.

On a warm autumn day when the frosts have stopped the honey flow and the bees can easily be attracted to the bait, the box is set up on a stump or stand in a field near the woods. Now a piece of comb is burned or a few drops of oil of anise are poured on the stump to attract the bees. If there are any wild bees in the immediate vicinity, the first one will usually appear within a few minutes. As soon as she locates the comb filled with honey or syrup, she drinks her fill, rises, circles slowly in order to locate her home, and then makes a "beeline" for it. We need a quick, sharp eye to follow her line of flight. In a few moments she will return, and in a brief time two or three of her fellow nectar gatherers will probably also arrive. We should have a definite line established after we have watched them depart once more. The next step is to move the box two or three hundred yards to one side and get another line. The tree is located where the two lines cross.

Sometimes the bees have come from such a distance that the two

◀ **HONEY FROM AN OIL WELL!**  
The hoard was discovered in the vertical Samson post of this abandoned well



lines are not easily distinguished. It may then be necessary to follow the bees for some time. So we keep some of the bees in the box by means of the glass cover and the stopper over the hole at one end. We release the bees at intervals of a quarter of a mile or so. As we get closer to the tree, the bees become more numerous. A hundred or more of them may be fighting for a place on the comb in the box. A pair of good field glasses or binoculars is now a help, for with them we can examine the trees ahead and possibly locate the entrance to the hidden store of honey.

This is a reliable and tested method of finding a bee tree, but you will have to use patience at the beginning. And do not be surprised if you follow the bees straight into a farmer's hive. Many an experienced bee hunter has done just that.

When the bees are rearing their brood during the summer months, some of the members of the colony assume the duty of water carriers. They locate the nearest supply of fresh, clear water, preferably where there is sand or gravel on which they can perch while absorbing their supply of moisture. If you can find the watering place, finding the tree is easy. Bees are rarely far from good fresh water, so you may rest assured that you are near the tree. One summer I located four trees just by watching the bees fly away from roadside springs in

► AN INCONSPICUOUS HOLE the only sign. Comb extends above and below the hole in this maple in western New York State

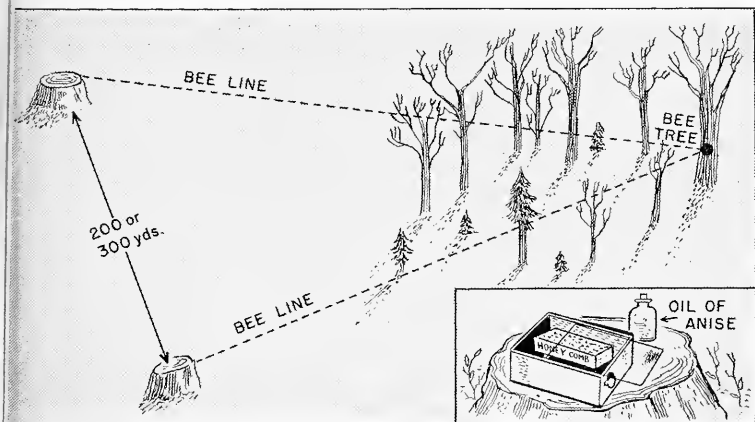
Virginia and Pennsylvania. All four trees were visible from the highway.

The third method of finding wild bees might be termed the accidental method. For example, last summer I located five swarms while driving along the highways of western New York and northern Pennsylvania. One was in a sugar maple, one in a white pine, one in a hemlock, one in a locust, and one in the partition of an unused barn. Old bee hunters say, "Always look for wild bees in a maple; they hollow out easier," but they may locate in any kind of tree if the cavity is large enough. I examined the swarm in the building by gently prying loose a board on the inside. The combs were almost white, showing that the bees had moved in that spring; and they were almost filled with honey, although the goldenrod flow had not yet started. I put the board back without removing any of the honey or further disturbing the bees. At other times I have accidentally found wild bees while wandering through the woods in search of pictures of plants or animals.

Perhaps I have used the word "tree" too loosely in the preceding paragraphs, for wild bees will make their homes in the most unexpected



places. Any cavity large enough to hold a sufficient amount of honey for the winter will be utilized. One swarm moved into a chimney during the warm months and was not discovered until the first fires were lighted in late October, when a rain of dead bees fell into the fireplace, along with a steady drip of sticky honey. Another swarm has occupied the six-inch pipe of a gas well derrick in Pennsylvania for some years. Soundings are said to show that the comb extends some 20 feet down the pipe. Need I say that the employees climb that derrick only during cold or rainy weather? We have found them in the Samson post of an oil well, between the studding in buildings, in an abandoned box trap once used to catch rabbits, in stumps and logs, and between the shutter and window of a hunting camp. The latter made a perfect observation hive. A swarm in Washington moved into a hollow metal post supporting a fire alarm box, and another was said to occupy the





◀ A DEAD WILD CHERRY tree that yielded 40 pounds of honey and comb. No tree should be felled without the owner's permission and a reasonable share of the honey. Many leave the bees to starve. These were hived and kept over the winter as they should be

▼ ONE OF THE COMBS has just been removed, and the hunters are scraping the bees and wood chips from it. The bees from this hive are now working for a farmer

forearm of a statue in Richmond. Still another swarm chose the drawer of a bureau that had been left on the porch of a Maryland farmhouse. One more swarm in Maryland could not find a hollow, so it built its comb outside against a tree trunk. Wild bees, then, are like gold—"It's where you find them that counts, not where you look for them."

Wild bee hunters are somewhat like fishermen in that they often tend to exaggerate their catch. Rarely does a bee tree yield less than "a washtub full of honey." You hear of "half a dozen buckets and a dishpan full" or "all the pans we had in the house and then some" or "more than a hundred pounds." Actually, the amount of honey depends upon several factors—the size of the cavity, the strength of the swarm, the number of years the bees have inhabited the tree, and the weather during recent seasons. When the swarm moves in, the bees have to build comb, and between seven and twenty pounds of honey are said to be necessary to make one pound of comb. Thus if a small swarm moves in late in the season, some comb will be made, but there will probably not be time enough before frost to fill that comb with honey. The bees, of course, will starve during the winter. I have seen trees cut that had comb but no honey, and I have seen others that had 100 pounds by actual weight. The average yield is about 40 pounds. However, an apiculturist with the United States Department of Agriculture informed me that there are

records of trees yielding several hundreds of pounds.

The quality and type of wild honey will vary considerably according to location, climate, and the number of years the bees have occupied the tree. Usually bees are temporarily constant to a single species of flower, but each comb may contain a mixture of apple, wild cherry, tulip, basswood, clover, buckwheat, goldenrod, and many other flavors depending upon the part of the country in which it is found. The new comb will vary from water-white to light yellow, and the old comb will be black and tough. The comb is usually broken open when the tree is felled, so that the honey is mixed with brood, dead bees, sawdust, chips, and dust. Consequently, it has to be strained before it can be eaten. Nevertheless, many people like the mixed flavor—so many, in fact, that some bee hunters make a business of selling the product in small jars at fancy prices. Personally, I like one flavor at a time, and I prefer that in comb honey taken from a professional beekeeper's hives.

The honey is usually strained by placing the crushed combs in a muslin bag and hanging it above the kitchen stove. The heat melts the wax capping of the cells, and the honey drips through the bag, straining out whatever foreign matter there may be in the comb. The beeswax is also preserved, either to be sold or to be used for waterproofing footwear, to make flatirons glide more smoothly, or to use on thread.

Any beekeeper can tell you that



his charges require constant attention. He must protect them from rodents, larger animals, and diseases such as American or European foul brood, which can decimate a colony in a short time. Because wild bees do not enjoy that protection their chances of survival are proportionately less. Death of or injury to the queen may cause the colony to die out. Foul brood is always a danger. In fact, many commercial beekeepers advocate the destruction of wild bees because they cannot be controlled and may serve as a source of infection. However, surveys have indicated that there is no more than one or two per cent infection among wild bees. I have never found foul brood in a bee tree, but I do know of one infected swarm taken from a church steeple in Maryland. Mice, rats, and squirrels will disturb the bees if they can gain en-



trance to the honey combs. One swarm between the partitions of a barn was raided so often by rats that it finally left. The rats gnawed the combs so that there was a constant smear of honey on the boards.

Some of the larger animals, especially bears and skunks, are destructive to wild bees. The bear's liking for honey is well known; it will risk almost anything to get at a store of sweets. I found one swarm of wild bees in an old white pine stump, but when I returned to examine it, there was nothing but splinters, broken comb, and angry bees buzzing around. The bears had found it and had eaten all the honey. On one occasion I watched a bear attempt to break into a gnarled old maple that had long been the home of a swarm. He was clinging to the tree with three legs and trying to claw an opening into the store of honey with his free paw. Every moment or so he threw his head back and wiped the bees from his vulnerable nose. The bear's fur is so thick that the bees cannot penetrate to the skin, but his nose is tender. Finally he gave up and backed down the tree. Then he looked up at the branches in utter disgust and ambled away through the timber.

Skunks will disturb bees if the entrance to the tree is low enough for them to reach it. One swarm of bees was entering an old white pine about two feet above the ground. One evening I saw a skunk approach the tree and scratch around the knothole. Immediately the bees boiled out to repel the intruder, but he stood his ground. When he had several bees in his fur, he calmly began to pick them out with his teeth. Apparently the skunks like the acid taste of the honeybee.

The chief enemy of wild bees, as of other wild things, is man with his ax and saw. All too often he cuts the tree to obtain the honey and then burns the bees to prevent their coming to his bee box when he hunts further. Sometimes he kills the bees with sulphur smoke before he attempts to open the tree. That procedure saves him

a few stings, but it may scent the honey. He may cut a block out of a tree early in the summer, remove what honey there is, and then leave the tree open to invasion by other enemies. These practices, of course, reduce the number of bees, which supplement the activities of our native bees in fertilizing so many of our domestic wild flowers and trees.

Some years ago almost every farmer had a hive or two of bees tucked away in the corner of the orchard. The bees helped to fertilize the blossoms of his fruit trees and other crops, and the sale of honey added a few dollars to his cash income. Because farm labor is so scarce or because mechanization has made so many one-crop farms, the bees have to some extent been given up. Commercial beekeeping on a large scale has, it is true, increased for some years, but here, too, a slight decrease was noted in 1948. Wild bees, on the other hand, seem to be increasing somewhat where second growth timber has become large enough to harbor them. I suspect that a census of wild bees would show that they are far more numerous than we have ever imagined. For example, I set up a bee box in my back yard in a residential section of Washington, D. C., and within an hour bees from four different swarms were carrying the honey bait away. It might be thought that they came from bee enthusiasts in the city or from outlying rural districts, because bees will travel several miles from their nest. But two of the bee trees were located in the vicinity of the zoo, a third was back of a famous hotel, and the fourth, we believe, was near the estate of a legation, although it was not located exactly because cold weather caused the bees to cease working. If there are four trees in this vicinity, there must be many more in the parks and nearby woods of Maryland and Virginia.

Since bees are so essential to the fertilization of our agricultural and forest crops and since the bees are disappearing more and more from

our small farms, I believe that we should use greater judgment in the cutting of bee trees. If we must cut the tree to see how much honey is inside, at least let us hive the bees and feed them through the winter so that they may work for us during the following summers. Whenever bees are killed or left to starve there will be two swarms less next year, for each one would have divided at least once. If the tree in which the bees live is a good solid one except for the hollow limb containing the comb, or if the tree marks a corner or boundary between farms, leave it as a source of supply of other swarms. We will profit in the end through better crops and flowers.

All too frequently the bee hunter looks upon a bee tree as his own private property regardless of who the real owner may be. I know of at least two fine maple trees that were cut on the property of a water company. That property is also a state game preserve, and both the state and the water company had "No Trespassing" signs attached to the wire fence surrounding it. Apparently there are some people who cannot read, especially on a dark Saturday night in October. The trees were left to rot while the bees were left to starve. No bee tree should be cut without the permission of the owner, and he should be given some choice combs for his kindness.

Sometimes when the bee hunter finds a nest that has not yet reached its peak of honey production, he will "stake his claim" by marking the tree so that other hunters will know of his prior discovery. It is interesting that certain Indians in Paraguay and Mexico are also known to use property marks in the same way to establish their right to wild honey, as mentioned by Herbert F. Schwarz in his recent monograph on stingless bees.

"To the farmer the honeybee is worth fifty times the honey she produces," someone has said. Let us protect the wild bees, or, if you wish to eat wild honey, at least preserve the bees in a hive. That is only common sense.

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# Natural History CRYPTOMAZE

FISHES By EDWARD DEMBITZ

**PART I.** In this puzzle you are given a set of definitions, each with a set of blank spaces, and a diagram to be filled in. Each definition is a clue to a word whose letters you are to insert in the blank spaces preceding the definition. These words appear in recent issues of NATURAL HISTORY Magazine.

- |    |    |    |    |    |    |   |   |
|----|----|----|----|----|----|---|---|
| 8  | 9  | 4  | 22 | 16 | 12 | 23  | Mossy area—a source of fuel, and sometimes used as a refrigerator (2 words)           |
| 14 | 15 | 12 | 11 | 19 | 5  | Plant whose leaves form exclusive diet of Great Spangled Fritillary caterpillar |   |
| 18 | 15 | 4  | 22 | 13 | 25 | 20  | Genus of ostrich-like birds that lived in Wyoming about 50 million years ago          |
|    | 8  | 24 | 15 | 10 | 25 | Roman naturalist (A.D. 23-79) who gave many plants their present names          |   |
| 22 | 17 | 7  | 6  | 15 | 10 | 15  | A kind of fly whose larva is the chief enemy of the monarch butterfly                 |
|    | 21 | 1  | 11 | 5  | 7  | 6   | Material laid down in oyster farms as points of attachment for spat                   |
|    |    | 2  | 1  | 10 | 23 | Dynasty during which Chinese domesticated the goldfish                          |   |
|    | 4  | 20 | 12 | 9  | 16 | 17  | One of the simplest known animals, named from the Greek "to change"                   |
| 14 | 19 | 13 | 12 | 10 | 15 | 21  | Widespread genus of herbs; also called the speedwells because of their brief blooming |
|    | 2  | 3  | 15 | 10 | 3  | A reptile. One letter keeps it from being a harmless mammal that everyone fears |   |
| 2  | 4  | 24 | 12 | 20 | 12 | 10  | Given name of Swedish engineer lost in arctic balloon flight in 1897                  |

**PART II.** When you have filled in all the letters above, transfer them to the proper numbers in the boxes in the diagram below.

When the diagram is completed you will have a word maze which contains at least 31 names of FISHES of the world. To find one of these fishes, begin with a letter and move from space to adjoining space in any direction, including diagonally, until the name is spelled out. **You are not permitted to form double letters by jumping up and down on the same square.**

Copyright 1949  
By Edward Dembitz

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

**THREE PRIZES.** The three contestants submitting the largest number of names of fishes fitting this puzzle will each receive an autographed copy of NORTH AMERICAN GAME FISHES by Francesca La Monte, a well-known handbook published by Doubleday, Doran and Company.

Names of fishes must appear in bold-faced type in the main A-Z section of Webster's New International Dictionary—1948 (unabridged) in order to be eligible. Names in bold-faced type below the line at the bottom of the page are allowable. Different names for the same fish will be accepted. So will variants, alternative spellings, and scientific or technical names, providing they appear in bold-faced type. Flagrant disregard of the rules will disqualify a contestant.

In case of ties, duplicate prizes will be awarded.

Entries must be postmarked on or before May 1 and be received by May 6, 1949.

Winners and their scores will be published in NATURAL HISTORY for June 1949.

The contest is open to everyone except employees of the American Museum and the Doubleday Company and their families.

## THE MAN WHO GRABBED A SHOOTING STAR

*Continued from page 167*

interested spectators, too: the huge meteorite was a prize plum for the lucky museum that could first conclude a deal with the owner. But—who was the owner?

The lawyers for the iron company discovered at this point, with much satisfaction, that a similar case had been tried in Iowa in 1890. A zealous Iowa professor had rushed in and bought a meteorite stone—a small one—that fell in a field. He bought it, unfortunately, from the man who dug it up and not from the man who owned the land where it fell. The Iowa court ruled that the meteorite was *part of the land*. This made things look very bad for Hughes, since courts are notoriously respectful of established precedent. But Hughes' lawyers were not done fighting.

No one had seen the giant Oregon meteorite fall; no one knew how long it had lain in the wet forest, but obviously it had been there for quite a while. Hughes' lawyers simply argued that the great chunk of iron was an Indian relic. They brought forward Indian witnesses who testified that the meteorite had been worshipped and looked after and generally treated with the respect that white men accord important personal property. And Indian relics, by established law, are discarded personal property and belong to the person who finds them.

It was a good argument, good enough to give the opposing counsel a bad time until the verdict was announced. But again Hughes lost

the decision. His own industry and intelligence in moving the meteorite had cost him the case. The court ruled that if a white man, enjoying the mechanical resources of civilization, had had that much trouble moving the thing, the Indians could never have moved it and made it their personal possession, and so it must have remained a part of the land!

While the legal tug-of-war was in progress, the American Museum of Natural History, eager to acquire the scientific treasure, opened negotiations with both Hughes and the Oregon Iron and Steel Co. When the Court decided in favor of the Company (on July 17, 1905), negotiations continued with the established owner, and after a half year of offers and counter-offers, the Museum finally purchased the meteorite for \$20,600. Today it rests on display at the Hayden Planetarium.

Legally, in the United States, meteorites now belong to the person upon whose land they fall. But the skill and daring of Ellis Hughes still excite occasional doubts in admiring legal minds. For old cases have lately been found in Europe in which the courts held that meteorites could not possibly be part of the land but belonged to the first finder!

Perhaps someday the situation in America may be changed by legislation. The scientists who specialize in shooting stars would like to see all meteorites become public property, with the finders liberally rewarded. Meteorites are that rare—and that important to science.

## AMONG THE TURKANA

*Continued from page 159*

the dance that was readily understandable to us. At first it consisted mostly of jumping and chanting, the men bobbing stiffly up and down and alternating their jumps with those of the women who faced them in line. The monotonous chanting would continue for a time and then die down into comparative silence, after which it would begin again. The dancers did not confine themselves to this pattern exclusively, however. Presently they began their Elephant Dance, which must have originated long ago, for elephants are no longer found in this region. In it, the men formed a curving line, each waving one arm in sinuous imitation of an elephant's trunk. Now and then, in the more active periods of the dance, the men—who alone took part in this movement—rushed at the women, who surrounded them, laughing and swaying; and then everyone would shout excitedly. As the women moved about the men, they coquettishly flipped up their goat-skin aprons in the men's faces. The children ran and jumped beside the dancers, but no attention was paid to them, and they came to no harm.

Neither did the dancers cease their now almost continuous rhythmic jumping nor offer objection when Mr. Whitehouse took us directly in among them for a close-up. Actually, they pushed one another aside so that we could see into the middle of the circle, which had then been formed by the dancers holding hands. The performance seemed to be some odd version of our own children's game, "Farmer in the Dell." A man, stamping, jumping, and darting about in the ring, would choose a woman and pull her in beside him. She, in turn, dancing about, would grab a male partner to the accompaniment of much yelling and laughing as they all pushed one another about. Though all appeared to be violently excited by that time, the Turkana remained both polite and considerate as far as we were concerned, and we enjoyed the fun.

**Winners of the Western Hemisphere Bird Cryptomaze** in the February issue of *NATURAL HISTORY*: The three contestants submitting the highest number of birds listed in the main section (A-Z) of *Webster's New International Dictionary—1943* (unabridged), in accordance with the rules of the contest, are: DR. HENRY S. RICH, Bronx, N. Y.—44 birds; RICHARD C. BEIDLEMAN, Fort Collins, Colorado—39 birds; AL ANTHONY MANTOVI, Staten Island, New York—33 birds. Each of these winners has received an autographed copy of the *Audubon Bird Guide—Eastern Land Birds* by Richard H. Pough, published by Doubleday and Company.

Technical or scientific names of birds were counted only if they appeared in bold-faced type. Scientific opinion favored the inclusion of Hawaiian birds as being of the Western Hemisphere but not birds from regions west of there. Variant spellings of the same name were not counted, but different names for the same bird were. In a two-word name it was not permitted to use two points of departure.

As darkness fell, the dance grew wilder and began to take on such erotic characteristics that Mr. Whitehouse tactfully suggested it might be best to return to his house. There, after a late dinner, we climbed the stairs to the flat roof where we could relax in comfortable deck chairs. From this vantage point we looked off across the desert-like country, so fascinating in the strangely white equatorial moonlight. We talked of these people, now so friendly, once so warlike. Off in the distance, with their fires still glowing redly through the

night, the Turkana were going on with their dancing and shouting. And even when we had thanked our host and returned to camp, the dance continued. As we fell asleep we could still hear the faint and rhythmic native cadences.

Throughout the length and breadth of Africa the forces of civilization are constantly at work, changing the ways and ideas of the natives. But in northwestern Kenya the Turkana see little of these changes, and they are decidedly resistant to such forces as have come from beyond their own bor-

ders. They seem likely to retain their habits and customs longer than many other tribes; yet, in time, no doubt even they will change.

The material collected by our expedition and brought back to the American Museum of Natural History shows a cross section of the life of the Turkana of today, and in view of the inevitable alterations the years must bring, we believe the collection will become increasingly valuable. And we know that the experience of visiting the Turkana was a privilege we shall never forget.

## DISCOVERING NEW ZEALAND

*Continued from page 179*

ried back with them to camp. We worked the clay till it was malleable and then pressed the leaves to be molded down onto it so that all the contours were in natural form. Little walls of clay were shaped around the edges to hold the plaster we poured on the leaves. We made it of the consistency of fudge frosting when you spread it. When firm, we did the same thing to the other side of each leaf. Bob had not made such molds for 40 years, and I had never made them, but they came out well for use by the preparators at home.

There were long lists of last things to do. I sewed up samples of the beach in cheesecloth—driftwood and all. We laid burlap bags on the forest floor and filled them with dead leaves and twigs and debris.

Think of the meticulous care put into the creation of a museum habitat group, sending stones and dead leaves half around the world! Bob cut bundles of sedge, and I tore fibers off flax leaves to tie them with. We caught the final pictures—red berries of the supplejack, red leaves of the pepper bush. We clambered over the rough track for the last time, the supplejack living up to its Maori name, tataramoa, which means something like trip-up-moa. Once I reached my hand to a tree trunk for support and was pricked by thorny lawyer. Near the camp, the track was smooth. Such beauty of gray-lichened trunks—gray warblers' passing—bellbirds calling. Such hurt always to be leaving what one has loved so much.

Yet there were compensations! We left our itching, too! There are several itchy insects in New Zea-

land. You think you are relaxed and have mental control of such an absurd torture, when whiz!—a wave of it sweeps over you and all your nerves are taut. Insect repellent should come in gallons, not in ounces.

The last sketch was made and the last picture taken. The last careful package was ready. "Tikinui" came.

But we had no rata. We could see the scarlet bloom on the eastern mountains, but no one had been able to get at it for us.

As we walked up the Te Kinga road, all the townsfolk greeted us by name, and a child ran out and gave us flaming rata flowers. The Group holds everything you need to see to know New Zealand as it was before men invaded its primitive perfection with their thoughtlessness.

## CONSERVATION

*Continued from page 146*

the problem presented by the private holdings that lie scattered within some of our finest National Parks. The Park Service has no control over the uses to which the private owners of these lands may put them, no matter how out of keeping these uses may be with the character of the surrounding park land. This year the Department of the Interior budget contains an appropriation of only \$300,000 for this purpose. At this rate it will take over 65 years to buy up these lands at present prices. Every year the value of the lands increases, and delay only increases the ultimate cost. In view of the millions of people who visit our National Parks annually, \$5,000,000 a year would be a much more reasonable amount to appropriate at this time.

These are only a few examples of the way conservation interests are being short-changed year after year. If you think conservation problems should be given more consideration, it is up to you to let your Congressman know at once how you feel, and in this case it would be advisable also to send a copy of your letter to The Honorable Clarence Cannon, Chairman of the Appropriations Committee of the House of Representatives.

Another example of our penny-wise, pound-foolish policy comes from the field of research. Congress years ago authorized a research vessel for the Fish and Wildlife Service, to enable it to start filling in the enormous gaps in our knowledge of our marine fishery resources. After Congress failed for five years to make good on this authorization, a private corporation finally gave a research

vessel, the "Albatross III," to the government, and now it is lying idle for an appreciable part of each fiscal year because of inadequate appropriations for its maintenance. When one realizes that many foreign governments are supporting several such research vessels and that the problems they are concerned with are vital to the future of a resource that is yielding many millions of dollars worth of food annually, the shortsightedness of such economies is quite obvious. There is little doubt but that the research that this vessel could carry on during the months when it is lying idle would pay for itself many times over through increased yields based on better fishing practices.

RICHARD H. POUCH,  
*Curator, Conservation and Use  
of Natural Resources,  
American Museum of Natural History.*



*May* **NATURAL HISTORY** *1949*

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# LETTERS

## Armadillos on the Increase

SIRS:

I am much interested in the letter regarding the spread of the armadillo in Florida in last month's *NATURAL HISTORY*.

I took a Kodachrome picture of an armadillo in Melbourne, Florida, in January, 1939. At that time it was rare and considered a curiosity. This January and February I saw two dead ones on the highway near Lake Washington and one about twelve miles west of Melbourne, also one alive on Merritt's Island. Friends have reported seeing them within one to three miles of Melbourne in different directions. No doubt about an increase in the past ten years.

J. M. HOLLISTER.

Melbourne, Fla.

## Baby Snails

SIRS:

My sister has a five-gallon aquarium in which she keeps three goldfish and a freshwater mussel. On February 26, she bought a snail, which five days later presented us with eleven babies. The next day there were six more, and on March 5, three, making a total of twenty. Each was born complete with shell and was about the size of a small pea.

The only book I could find has an illustration of a snail similar to ours and calls it a Japanese snail. The book says that the snail may be either male or female and that the female, once impregnated, seems to remain fertile for the rest of her life...

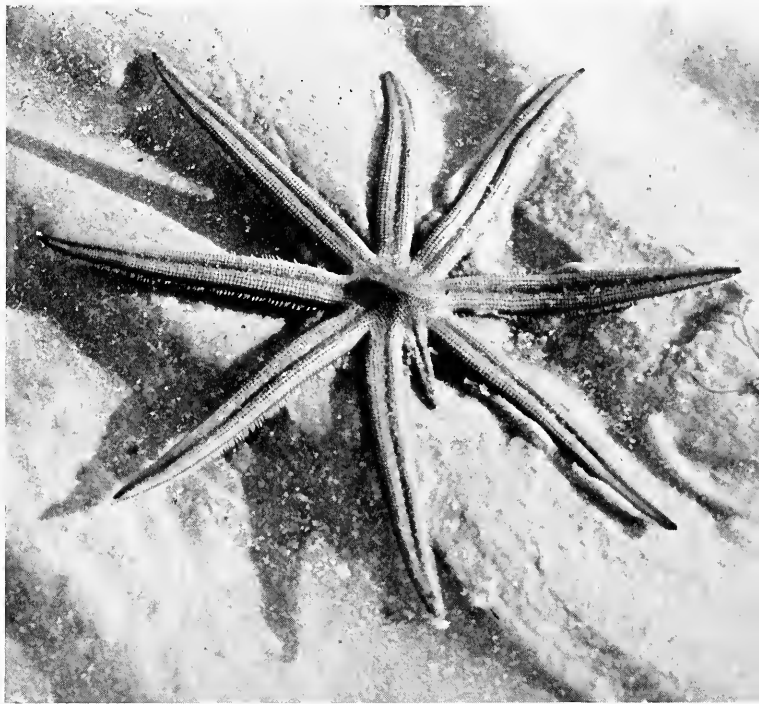
Could you tell me more about their reproductive habits?

ANN TRAINOR.

Elkhart, Ind.

The following information is offered by Dr. Libbie Hyman, of the American Museum's Department of Fishes and Aquatic Biology:

Nearly all fresh-water snails have both male and female reproductive organs in the same individual, but some do not. Those that do not, usually have a little round shell on top of the foot, which they use to close the opening of the shell when they withdraw within it. If a snail has this so-called operculum, then, it is one of the kind that is either male or female (dioecious) but not both (hermaphroditic). In many cases, it is not possible to tell



▲ THE NINE-RAYED STARFISH *Luidia senegalensis*. This is the most easily recognized starfish of the West Indies, because nine is such an unusual number for a sea-star. This individual is growing a new arm to replace one that was lost. In life, it is a bluish or greenish gray. Photograph by Hugo H. Schroder

whether one of these dioecious snails is a male or a female. In other cases, the male has a very obvious male organ protruding on one side, shortly behind the head.

If Miss Trainor actually has what is called the Japanese snail, belonging to the genus *Viviparus*, the males can be distinguished by the right tentacle, which is short and thick. Apparently this difference can be detected even in newly hatched snails. Also, the male does not grow as large as the female.

It is said that mating occurs only once in the life of the Japanese snail, so that all of the young are the result of this mating. They are produced once a year, in spring or early summer, but it is usual for those of one batch to come in installments, as Miss Trainor reports.

This snail has what serves as a brood pouch in the space between its body and the mantle. (The mantle is the skin that lines the part of the shell that is free from the animal's body.) In this space the female lays its eggs, and they develop there

to the point of being small snails. The presence of these young can be seen in mature females, thus providing another way of distinguishing the sexes, though it is only applicable, of course, to sexually mature individuals.

Most all snails have a courting behavior similar to that described in *NATURAL HISTORY* for February, 1947. They usually don't hang on threads as that one did, but otherwise the behavior is much the same. Although hermaphroditic snails can fertilize themselves, they mate just the same as dioecious ones do. In fact, the article in *NATURAL HISTORY* was about a hermaphroditic snail.

## Junior to Senior

SIRS:

I would like to compliment you on the different and unusual subject matter that has appeared on your magazine covers, such as the January, 1949, issue.

I have never seen this magazine before. In grade school we had the *Junior Natural*

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H. LEYER.

Seward, Alaska

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What problems confront those who would explore the realms of interplanetary space? What do we know of conditions that exist in the upper reaches of the atmosphere and beyond? These are questions that will be seriously considered in the Hayden Planetarium during May.

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At the same time, the lecturer will discuss the latest information concerning the moon and the planets, with special emphasis on the physical conditions they exhibit.



▲ PORPOISE JUMPING FOR FOOD in one of the stockade-pools at the Lerner Marine Laboratory at Bimini

# NATURAL HISTORY

*The Magazine of the American Museum of Natural History*

F. TRUBEE DAVISON, President

WAYNE M. FAUNCE, Vice-Director  
In charge of Publications

ALBERT E. PARR, Director

VOLUME LVIII—No. 5

MAY, 1949

Indian Chief.....Cover Design  
*From a Kodachrome by Clyde Fisher*

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You will find NATURAL HISTORY Magazine indexed in *Readers' Guide to Periodical Literature* in your library



## THE COVER THIS MONTH

This photograph of Chief Hind Bull was made at the annual Sun Dance near "Stand-Off," at a place called Belly Buttes, in Alberta, Canada. Chief Hind Bull is wearing a typical war bonnet of the Blood Tribe, made of eagle feathers and tipped with horsehair. This spectacular headdress originated in this area among the division of Indians known as the Plains Indians. Only since the coming of the white man has the feather bonnet become symbolic, in the popular mind, with Indians in general. Chief Hind Bull was dressed for his Medicine Pipe Dance, a part of the greater Sun Dance Ceremony. It was said that he gave away 22 horses and many other gifts on this occasion. He is one of a number of so-called Minor Chiefs of the Blood Tribe, the Principal Chief being Chief Shot-Both-Sides.

In western Canada, Indian reservations are known as Reserves. The Blood Reserve of 356,000 acres is the largest in Canada. The Blackfoot Confederacy includes, besides the Blood, the South and North Piegiens and the Northern Blackfoot tribes.

The photograph was taken by the late Dr. Clyde Fisher.

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#### THE TENETEHARA INDIANS OF BRAZIL

— by Charles Wagley  
and Eduardo Galvão

Columbia University Press, \$3.75  
200 pp., 12 plates, 1 map

AS exploration and colonization continue in Brazil's jungle-covered hinterland, it has been the fate of most primitive Indian societies to collapse before the impact of modern civilization. The Tenetehara Indians of northeastern Brazil, however, have been in contact with outside cultures for three centuries and yet have managed to adjust to changing conditions. Living an essentially aboriginal existence in the Amazonian rain forests, and without any understanding of commerce, they now operate within the world commercial system and are affected by market fluctuations in London and New York.

The Tenetehara's adjustment to a changing world is the subject of this fascinating and thoroughly readable book, the product of a happy collaboration between a

North American and a Brazilian anthropologist. The presentation of Tenetehara culture is balanced and full, and the workings of the society are explained clearly in terms of vivid anecdotes.

Although the essential core of Tenetehara culture remains aboriginal, much has been modified through contact first with the Portuguese and later with rural Brazilians. The resulting changes in economics, social organization, religion, and folklore are traced with skill, and numerous comparisons are made to related, but less acculturated, Tupi-Guarani speaking tribes.

The authors show how minor changes, once accepted, may set up a "chain reaction" throughout the fabric of a culture. Thus the Tenetehara first acquired a taste for manufactured goods. Subsequently their economy was modified from one of subsistence to one of production in order to obtain trade articles. Today native ceremonies are being abandoned because current economic conditions simply do not allow the Indians the time to perform them. Having swallowed the initial bait—and in view of increasing pressure from without—it is only a question of time, the authors believe, before the Tenetehara become rural Brazilians.

HARRY TSCHOPIK, JR.

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— by E. Laurence Palmer

Whittlesey House, \$7.00  
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Extensive as is this field book, Dr. Palmer had to leave out a section on historical geology, a section on galls, and some two hundred additional plants and animals which he had already prepared, just to make room for the sections on stars and rocks and minerals.

The author has included some of the more important domesticated plants and animals along with the wild ones because he believes "that people want to know more about cows, corn, cod and chickens."

Much of the material was rewritten from the Cornell Rural School leaflets, sponsored by the New York State College of Agriculture, and from inserts which appeared in *Nature Magazine*. The illustrations, most of which are excellent line drawings (the rocks and minerals and mollusks are photographs), number over two thousand and are the work of a corps of skilled artists, including the late Mary Eaton, Mrs. E. Burckmyer, and the late Louis Agassiz Fuertes. Scientific names as well as common names are used throughout, and the text is simple and nontechnical.

The purpose of this book, which was actually a decade in the making, is best given in the author's own words, "... the author has endeavored to write the kind of book he would have liked to have available when he began the study of natural history as a youngster, as well as a book he can use now and in his old age to add the research and experience of others to what he may see for himself in his experiences with natural history."

JOHN R. SAUNDERS.

## COUNCIL FIRES

by Ellsworth Jaeger

Macmillan Company, \$2.95, 253 pp.

HERE is an excellent title for the subject. It immediately brings to mind stars, trees, wind, night sounds, and the fragrance of cedar smoke. Is there a person anywhere who has not been thrilled to sit beneath a night sky, near a campfire, and listen to ancient stories?

Ellsworth Jaeger, Curator of Education at the Buffalo Museum of Science, has long been associated with camping and has written such books as *Tracks and Trailcraft*, *Wildwood Wisdom*, and *Easy Crafts*. He knew Ernest Thompson Seton, a master of ceremonies and without question one of the great storytellers of our time, and he includes in this book some of the lessons he learned.

In this volume there is a wealth of detailed information, copiously illustrated with pen-and-ink drawings. Step by step the author shows how to plan and stage a successful Council Fire. In detail, he explains the making of various types of Council Rings, then follows with the many articles to be used in the ceremony, musical instruments, clothing to be worn, then how to hold the council with dignity and impressiveness. A few Indian melodies are included and some colorful adapted Indian dances.

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*Council Fires* contains an amazing amount of information and appears at just the right time to remind every camp director that it should have a place on the library shelf this summer.

TE ATA.

## THE ART OF FISH COOKERY

----- by Milo Miloradovich

Doubleday & Company, Inc., \$3.50  
457 pp.

MISS MILORADOVICH, who is an old hand at cookbooks, here gives us a book of world-wide scope and extremely detailed information. It covers fish and shellfish and also includes frog legs and whale meat.

There is a short description of the appearance, average size, general distribution, and abundance of each animal. Market forms, seasons, and producing areas are given in tables. Market cuts are illustrated. We are told how to clean and dress fish and how to shuck shellfish. Standard measurements both dry and liquid are listed. The cooking time is clearly stated in each recipe, as is also the state (very hot, cool, chilled, etc.) in which the dish should be served. There is a list of wines to be served with the various dishes.

There are recipes for smoked, salted, canned, and frozen, as well as fresh fish, and the author tells us what canned products may be substituted for fresh. There is, finally, a good index.

One thousand two hundred eighty recipes are contained in this smallish book, which nevertheless is printed in very legible, good-sized type. There are recipes for canapés, sandwiches, salads, broths, chowders, bisques, fumet, and bouillon; patties and puffs; sauces and stuffings; and every possible variety of broiled, boiled, baked, fried, and otherwise prepared fish and shellfish. The book is designed for use anywhere in the world and is not confined to our own fauna.

The jacket of *The Art of Fish Cookery* fails to state one important fact: Every recipe in this book has been actually tried. They have, moreover, been tried in ordinary kitchens. In telling how to make these dishes, the author does not assume the presence of a slave who can, as one old southern cookbook casually directs, "beat three hours," or of a staff of cooks and scullery maids. It does not even assume a technical knowledge of cooking terms. It is a well-organized, clearly and very appetizingly written book by an author who obviously knows all about fine food from the raw material to the final mouthful.

FRANCESCA LAMONTE.

## THE WOLF AND THE RAVEN

----- by Viola E. Garfield  
and Linn A. Forrest

University of Washington Press, \$3.00  
151 pp., 67 photos

OF all artistic productions of North American Indians, totem poles, perhaps, have aroused the greatest public interest and curiosity. When and where these unique monuments originated, who made them, and what they mean, is the subject of the present book.

Totem pole carving was confined to the Tlingit and related Indian tribes of southeastern Alaska and western British Columbia. As popularly used, the term is made to embrace several classes of carvings that had quite different functions; some served as memorial columns or house posts, while others were grave markers or family crests. The carvings depict the heraldic devices of families and lineages or illustrate the mythological exploits of animals, birds, and supernatural creatures. Because of the complexity of this highly conventionalized art style and of the native mythology, the interpretation of totem poles requires an intimate knowledge of Northwest Coast symbolic art as well as familiarity with the legends. The bulk of the book consists of photographs of totem poles and of accounts and explanations of the myths.

Today Northwest Coast wood carving is almost a lost art, and many of these fine monuments lay rotting in deserted Indian villages. In order that some might be preserved, the United States Forest Service collected a number of totem poles from abandoned towns, restored them under the supervision of native artists, and erected them in several Alaskan parks. It was this project of restoration and study that led to the preparation of the present volume by an anthropologist and a Forest Service employee respectively.

Although a systematic summary of Northwest Coast culture would have contributed materially to a clearer understanding of both carvings and myths, this book should appeal to those interested in Indian art and folklore and serve as a useful guide to the totem pole parks of Alaska.

HARRY TSCHOPIK, JR.

## CRUICKSHANKS AWARDED JOHN BURROUGHS MEDAL

Allan D. and Helen G. Cruickshank were awarded the 1949 John Burroughs Medal for distinguished literature in the field of nature.

The bronze medal was formally presented to Mr. and Mrs. Cruickshank at the John Burroughs Annual Birthday Celebration on Monday, April 4, at the American Museum of Natural History. The award was in recognition of "Flight into Sunshine", the story and pictures of the Cruickshanks' photographing trip into Florida.

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AMNH photo

▲ HAIDA TOTEM POLE  
carved in stone

WE had often seen argillite carvings in museums, and we took it for granted that they were of historic interest only. But when we came upon carvings in shops in Vancouver, we began to suspect that the ancient art was still alive. When we reached the Queen Charlotte Islands, off the coast of British Columbia, we discovered that the art was practically on its deathbed.

Louis Collison, sixty-year-old Haida Indian of Skidegate Mission, is the last of the old masters. He still works with a true eye and skilled hands, though he says sadly, "My father was better, and his father better still."

Louis himself carves the soft carbonaceous shale only in his spare time or when he feels like it. There's more money to be made with his fishing boat, going out after dogfish livers or trolling for cod or salmon. But when winter brings the furious storms that turn Hecate Strait into a maelstrom of angry waters, he unearths some of the stone from a storage pit in the back

yard and sets to work. His is the best work being produced today, although another aging, half-blind native may turn out a greater quantity of inferior craftsmanship.

The Haidas of the Queen Charlotte Islands were long known for their artistic skills, being culturally one of the most advanced tribes north of Mexico. Their craftsmanship in metal, stone, and wood set them high among the North American tribes.

Apparently the carving began with dishes, amulets, pipes, and other small objects that were not strictly useful but were real works of art. Some were inlaid with iridescent abalone shell. Even then, travelers bought any they could find.

"These stone carvings are eagerly purchased by persons looking for Indian curiosities," wrote James G. Swan in a Smithsonian Report in 1874, "and are generally regarded by casual observers as idols, or objects of worship or indicative in some manner of their secret or mystic rites. This is however an

▼ LOUIS COLLISON, the last of the old masters, carving a totem pole with simple tools but in perfect symmetry. The design tells the legend of the Raven Stealing the Sun



Last of

error. None of the tribes of the northwest coast worship idols or any visible symbol of their secret religion."

The Haidas found their "slate" carvings excellent items for barter with the mainland tribes, who in turn sold them down the coast to white traders. Wood and argillite carvings made to serve the native intertribal demand soon became important in the eyes of the natives.

Later the carvings became largely totem poles, miniatures from four inches up to twenty-four, though the latter are quite rare. These stone poles stylized the same designs that were used on the tall wooden totem poles. Argillite carving began around 1820, as far as can be discovered, and the totem poles did not reach their "golden age" until 1840-60. Wooden totems have not been carved on the Charlottes since 1880.

Louis Collison remembers all this. He is familiar with the work of the most outstanding of the argillite carvers, Edenshaw and Chapman of Masset, Queen Charlotte Islands. These two lived in the same village, but one was a chief, the other a freed slave. It was beneath Chief Edenshaw's dignity to notice the work or even the existence of the crippled slave. But they were rivals, nonetheless.

Fortunately for posterity, their work has been preserved in the Cunningham Collection in Prince Rupert. A shrewd trader, George Cunningham would show Edenshaw the latest of Chapman's carvings. The chief would snort—and bring in something better next time. But the honors remained even, for both were masters of their craft. Chapman, however, with his alien background, could draw upon the legends of his mainland tribe for inspiration.

An interesting feature about the Northwest tribes was that certain elements of their culture were regarded as personal or clan property. Songs, dances, stories, and totems could not be used by outsiders. That attitude persists today in a lesser degree. A craftsman now may sometimes obtain permission to use some other clan's motifs.

When we introduced ourselves, Louis Collison was in the process of carving the famous story of how Raven brought light to the dark earth he had created. In the complicated tale, Raven stole first the box of starlight, but that was not enough light. Then he managed to steal the moon, but the earth was still too dark. At long last, he contrived to snatch the box containing the sun and attempted to fly away with it. Unfortunately, he got caught



AMNH photo

## the Haida Carvers

The satiny-black stone carvings of the Northwest Indians win the esteem of all who see them, but they represent a dying art

By LYN HARRINGTON

Photographs by RICHARD HARRINGTON  
except where otherwise credited

in the smoke hole of the lodge long enough to have his snow-white plumage permanently blackened. But he had light for his earth.

Louis Collison (his name was taken from one of the missionaries of a century ago) spoke infrequently and in soft, slurred English. He was distinctly shy in my presence, so on later visits I kept well in the background. He became friendly and at ease with my husband, eventually permitting him to take these photographs of the process. For so shy a man, this

represented a great concession.

Only one deposit of the argillite is known along the coast. It is at the foot of Skidegate Inlet, halfway up the slope of the Slatechuck Mountains. Two years ago Louis made the long and arduous climb up the steep trail, now overgrown and cluttered with the debris of logging operations. Carrying pick and shovel and crowbar is no light chore for an elderly man, and on the return trip he had to carry the heavy rock, as well. But he had enough to last him for several

years, at his present rate of production.

The argillite is really a carbonaceous shale. Sometimes it is called Haidite. Locally it is always called slate. It is relatively soft when first quarried, containing about eight per cent water, and is then easily carved. Upon exposure to air, the moisture evaporates and the rock becomes very brittle and easily split. To keep it in workable condition, Collison wraps it in moist cloths on the way home, then coats it with glue, and finally buries it in the earth.

He does all his carving by hand. On occasion, white neighbors have pointed out that he could make much better time with a power tool. Louis just smiles and says, "Yah," in his gentle drawl. Power tools have been tried, it seems, but the slate chips too readily.

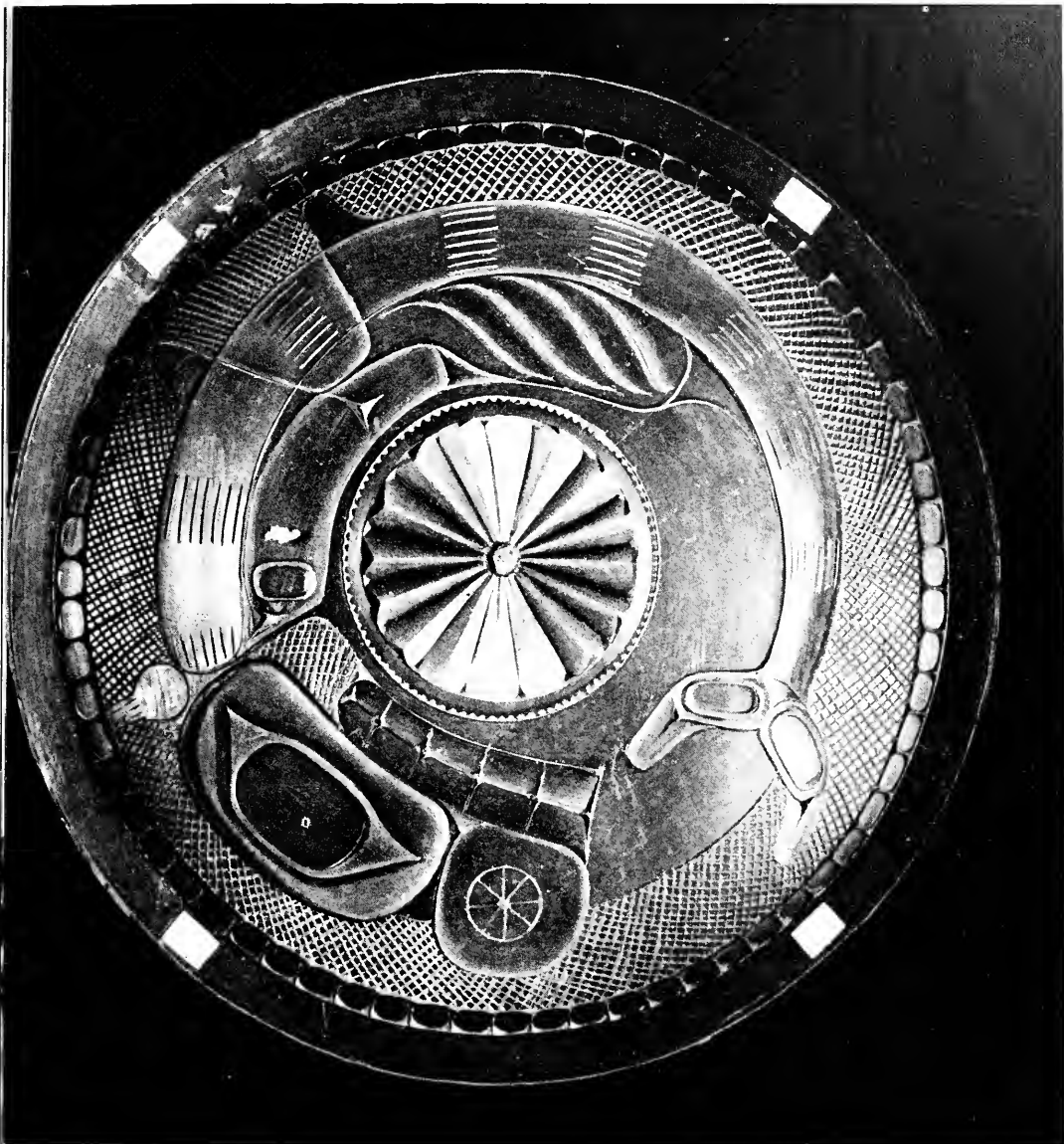
When the mood to carve comes upon him, he saws a piece off the block with an ordinary handsaw. This piece, too, he coats with glue to keep it workable. He tried wood-working tools but didn't like them. So he made his own, sometimes a flattened nail or an oft-sharpened paring knife. The argillite is quite



▲ LOUIS COLLISON sawing a block of the dull, dark shale to approximate size. It is kept coated with glue prior to use, to preserve its texture for carving

➤ FINISHING TOUCHES with a tiny chisel made from a flattened nail. Mr. Collison spurns the use of power tools and other special equipment





▲ A "SLATE" DISH carved by the Haida Indians off the coast of British Columbia, in the collections of the American Museum of Natural History

AMNH photo

easily carved, being about as hard as plaster though of a different consistency.

His tools dull quickly, but he can sharpen them on the whetstone in his boathouse. He knows in advance just what he is going to

carve and sets about it in a leisurely way, scraping and studying, turning the stone from side to side. He's never rushed.

Collison carves all his figures on three sides, leaving the back straight and smooth. His figures are

exactly symmetrical, perfectly balanced, which is no small trick for anyone and quite remarkable for a fisherman untaught in the arts.

When he has finished carving, the material is still dull, dark gray in appearance, showing the tool marks. These he eliminates with sandpaper of various grades, until the entire surface is smooth and satiny. He digs into the confused litter of a drawer in his small



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▲ CARVED BOXES, showing characteristic ornamentation of the Northwest Coast Indians. American Museum Collection

worktable, brings out a scrap of cloth, and smears it with vaseline. He scrapes a bit of graphite off a soft, large logger's pencil and rubs the carving with it until it is black and shiny.

"They used to use shoe polish or stove polish on them," he said. "But that don't last long; rubs off." This finish is long-lasting and not only adds beauty but acts as a preservative.

The vaseline and graphite mixture is rubbed thoroughly into every little crevice of the carving and worked into the porous rock. Then Collison buffs up the carving until it gleams with a high gloss, a shiny jet-black piece of true Indian carving.

When my husband asked if he would carve a six-inch pole for him, he rubbed his stubble cheek with the back of his hand. He hemmed

and hawed, didn't have time, was already two years behind with orders . . . Well, when did he want it? Two weeks? Louis wasn't sure, didn't think it likely. But the pole was finished when we returned, sure evidence that Louis had taken a fancy.

A six-inch pole might take two or three days to complete, and his rate of \$1.50 an inch is certainly not unreasonable. It always makes for a better feeling all around if there's a slight overpayment! Considering the skill that goes into making the beauty of the true argillite carving, the price is certainly trifling.

This is only one reason why it is not popular with the young people. The main reason is that the Haidas are a proud people, long the lords of the West Coast. They do not want to maintain differences

between themselves and the dominant white man. Native crafts that widen the gap between the two races haven't much appeal for these people.

"Fella over in Rupert wants lots of pieces," Louis told us with that slow wide smile, and shrugged, "I dunno . . ." Whether the fellow in Prince Rupert would ever get them was questionable.

The argillite carvings sold in Prince Rupert are perhaps the poorest examples ever placed on the market. Fantastically enough, it was one of these crude carvings that was chosen as a master-mold for turning out plaster reproductions en masse. These brought a price almost like that of the original slate carvings, from tourists on the steamships who didn't know the difference.

It is not the first libel on the  
NATURAL HISTORY, MAY, 1949



native craft. Before the war the Japanese mined and carved the argillite, easily copied the Indian style, and turned out fine workmanship. The leisurely native pace was no competition for the industrious Japanese. But in order to preserve both the craft and the source of the material for the natives, the Department of Indian Affairs of Canada bought the entire area and reserved it for them.

Louis Collison learned to carve by watching his elders and by application. That's the way to learn the art, he feels. When the Department asked him to teach the native children in the village school, he acquiesced, but his shrug indicated that it was uphill work. The youngsters took it as another lesson, something to be gotten over with as soon as possible.

Possibly another artist will arise from among these pupils, or perhaps some of the young men who casually turn attention to the craft from time to time may yet produce some fine work. But to all appearances, Louis Collison is the last of the Indian masters in argillite carving.



▲ To give the stone its glossy black sheen, shaved lead pencil is mixed with vaseline and rubbed over the finished carving



◀ A SHOEBRUSH finally brings up the luster to the artist's satisfaction. Pride in a distinctive art is giving way to a desire to emulate the white man. After Louis Collison, there will be no one to carry on this tradition



▲ WHERE a creature cannot move without writing its diary. Those who imagine the desert a lifeless waste will be astonished at the abundance of tracks

# Tracks in Desert Dunes

Delicate patterns in the sand are the signatures of a host of desert creatures. Learn how to read the story of their unseen lives

By RAYMOND B. COWLES

*Professor of Zoology,  
University of California*

*Photographs by the author except where  
otherwise credited*



▲ OCCASIONALLY the badger noses along the dunes at night, searching for fringe-footed lizards

interesting adaptations make their homes in this wind-transported soil. Some of them show a preference for the outermost deposits, which are as fine as dust. Here many plants grow thickly, and the associated animals find ample cover. Other plants and animals live right up to the borders of the dunes, where the sand is as fine as that in an hourglass, while others, fewer in number, occupy the dunes themselves. These latter are the most specialized of all the sand-dwelling organisms.

The forces responsible for these sand dunes are, of course, the strong winds that are so frequent in desert territories; but paradoxically, the dunes are at their best only where the gales begin to weaken in force and therefore deposit their loads. Also, the dunes must have a source from which the sand can be brought. In desert areas, which are

OUR camp had been located close to the edge of a great expanse of desert sand dunes in southern California's Coachella Valley. Here, cradled beneath the towering, often snow-capped peaks of Mt. San Jacinto and San Geronio and the lesser desert ranges to the east, frequent winds of gale force sweep down over the sun-baked alluvial fans and dry washes, to create and maintain the miles of sand dunes that were our special objective on this trip.

This was a class on their first zoological field trip to desert regions, and we were engaged in the

study of the environmental conditions imposed upon plants and animals living in these areas. Until midnight the class had been subjected to a cold wind that howled around our sleeping bags, rattling gravel and sand against the canvas covers we had turned up over our heads for protection. However, by sunrise not a breath of air was stirring to suggest the previous night's turmoil. This was most fortunate, for the evening storm and morning calm meant ideal conditions for the special type of work we were hoping to carry out.

Plants and animals with many

often remote from any point of contact with either ancient or modern sea beaches, the only sand available is carried by the rare but usually violent rains and ensuing flash floods, which strip the adjacent mountains of an accumulated store of sand grains and gravel. These sudden torrents of water and debris smash downward, grinding boulders into pebbles, pebbles into sand, and finally sand into mud. Eventually the muddy, turbulent flood pours out over the alluvial fans and even to the desert's edge. On these slopes and on the deserts the water vanishes underground, leaving behind it a new cover of loose soil.

At this point the winds pick up where the water left off and whirl a new burden of sand to ever greater distances, winnowing the fine from the coarse until at last the air-borne load is deposited to form great stretches of uniformly colored sand, a mixture of the various-colored minerals of which the mountains were composed, sorted as to size and coarseness by the diminishing velocity of the wind.

One of the most important reasons for selecting this area for our work was the inestimable advantage of easy tracking. In the dunes themselves, as well as along the margins of fine sand and dust, almost all of the animals, both large and small, emerge at one time or another to write the story of their natural, unaltered activities. We had come to the desert in order to read these stories.

By their shyness and frequently by their nocturnal habits, most ani-

mals manage to conceal some of their more fascinating activities. Most life histories of small animals must be learned the hard way; that is, by long hours of patient watching in the field, in the hope of gleaning an occasional fact bearing on their lives by the chance detection of a few of those almost instantaneous episodes that take place. Observations on captive animals in the laboratory or zoo are extremely helpful, since they provide many valuable hints of what to look for. Nevertheless, such observations can be misleading and should be checked against the behavior of each animal as it lives in nature.

The shyness of animals does not

mean that they consciously conceal the secrets of their lives from us but that in order to survive at all they must vanish from sight at the faintest suggestion of a strange sound or movement. Therefore, only rarely do our thudding feet and imperfect vision allow a glimpse of their most intimate activities or of the often deadly serious episodes in their daily life. At best, their most dramatic moments are past and over within seconds or in a few quick heartbeats. In order that it too may live, a predator strikes down its prey, and panic, struggle, and suffering are over so suddenly that the would-be spectator very rarely sees any part of the action. The same situation is

*Eliot F. Porter, from National Audubon Society*



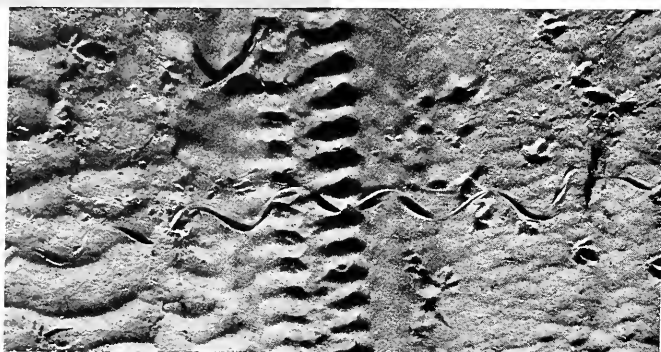
THE ROAD RUNNER can hold its own against a rattlesnake, but more often it patrols the sandy ridges searching for lizards. It leaves the footprint shown at left below a scorpion's burrow. Note the double line of footprints made by the scorpion as it emerged from its hole and returned



► **THE HARMLESS SPADE-NOSED SNAKE**, only a foot or so long, leaves a perfect serpentine curve in the sand. It is almost impossible to catch one on the sand, but at night they cross the highways

▼ **CAN YOU TELL** which way spade-nose was going? Other tracks here are those of desert quail, scorpion, and an unidentified mouse

AMNH photo



usually true of play, mating, and often much of the courtship behavior. Further, during the daytime when our eyes are able to see well, a vast host of nocturnal animals are either sleeping underground or carrying on normal activity in darkness and invisibility. Animals that are subterranean may also come to the surface chiefly at night, when we can see only faintly at best. It is for these reasons that sand tracking can prove to be a valuable aid to an understanding of an animal's life and can reveal much that is new, unknown, or possibly just guessed at.

To most people the sandy wastes of the desert seem to be devoid of life and interest. To the biologist or naturalist, however, it is soon apparent that the sand hills swarm with life of the most interesting kinds, much of it specialized for the peculiar needs of its existence. Most of the sand dwellers live either just beneath the surface or even deep underground, in either case in complete or almost complete darkness. But you may be surprised to find how vividly they leave their record during their al-

most universal night wandering.

Although records in sand are notoriously impermanent, the fact remains that they usually persist for hours or sometimes even days. Thus they provide a record that endures a thousand times as long as the dramatic event that took seconds for its completion.

The study of tracks and the reading of evidence on the way of life of desert animals is chiefly an art. Nevertheless, the use to which the information is put is a phase of descriptive science and requires some scientific training to be of the greatest value. Wholly new information on some details of the lives of birds, mammals, snakes, and lizards, as well as many kinds of arthropods, is easily available to the naturalist. The chief requirements for pursuit of this interesting activity are patience and average eyesight. Sometimes a modicum of fortitude in the face of high temperatures is needed, but the tracker is most active only during the most beautiful hours of the day—early morning and late afternoon. At either of these times the desert heat has moderated, and the nearly

horizontal sunlight reveals the full array of flamboyant desert colors, reflected from the sand and sometimes from rare clouds. Always the higher elevations of the mountains receive the first and last rays of the rising and setting sun.

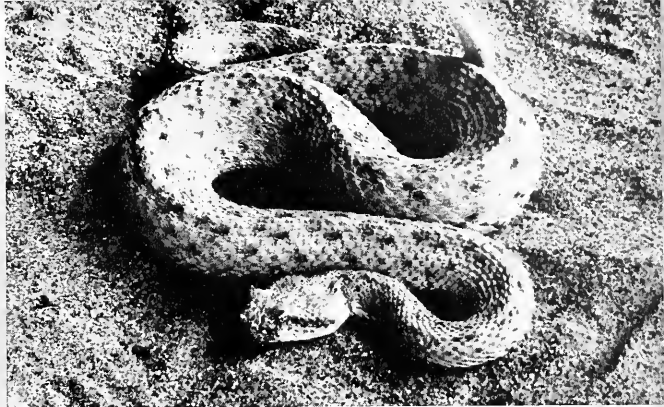
The naturalist chooses these hours near dawn and dusk not because the heat of the day is diminished but for the simple reason that the tracks show most clearly under such conditions. The harsh midday sun, with its vertical rays of glaring light, subdues the shadows and almost obliterates from vision the slight impressions made by the feet, tail, and, in some instances, the bellies of desert animals. When the light rays strike the ground obliquely, every inequality or disturbance of the dusty surface stands out so clearly that a photograph sometimes looks like a picture of some curious bas-relief.

Trackers try to walk toward the sun, or at least they work with the light shining toward them, for then the previous passage of an animal, even one as small as an insect, is marked by dark shadows against a high-lighted and universally brilliant background.

Beetles reveal their locomotory peculiarities by their curious outward-toeing prints. These sometimes suggest the footprints of a bird, because the three legs on each side of an insect leave imprints resembling those made by the three-toed foot of most birds. The most conspicuous difference is that birds do not toe outward so sharply or take such short steps.

Tracks of tarantulas and scorpions would be difficult to distin-

➤ THE SIDEWINDER leaves ladder-rung tracks that mystified scientists for a time. They are unlike any others you will see. Instead of wriggling, the sidewinder flows smoothly sideways like a flattened, rolling coil. Note marks left by the belly scales



guish from each other except for the fortunate fact that sooner or later scorpions drag their "tails," leaving an identifying middle track. When scorpions trails are first seen, and when the track ends in an obvious burrow, the novice is tempted to dig down to capture the occupant of the hole and discover who made these intriguing marks. By such rash tactics the identity of the occupant is often revealed with painful suddenness by a red-hot burn on the end of a finger. Fortunately, west of Arizona this burning sensation is the only symptom apt to follow such a sting.

You can tell a jack rabbit from a cottontail because the jack rabbit walks or runs, whereas the cottontail hops, simultaneously moving the hind feet while the front feet are taking single steps. The cottontail thus produces a curious clover-leaf pattern, which you will easily come to recognize wherever the animal has passed by. When frightened, it hops or leaps, bunching its feet to form another type of track.

Almost all individual trails are crisscrossed here and there by the tracks of two common desert liz-

ards. The tracks of the whiptail, *Cnemidophorus*, which are thin and rather sharply cut, are made up of toe markings separated by the groove of the lizard's trailing tail. Those of the desert iguana, *Dipsosaurus*, normally resemble those of the whiptail except for their larger size and thicker tail mark. When this lizard emerges from a cold burrow and has the temerity to walk across the open desert, the dragging toe-marks indicate the awkwardness and inefficiency of a reptile's locomotion when the temperature is low.

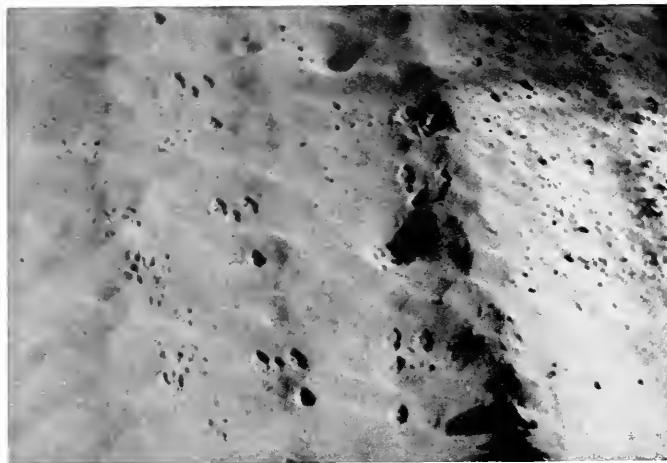
Sooner or later you will encounter the broad, "squatty" tracks of the flat-tailed horned lizard. In fact, the tracks will be much easier to find than the animal, for this rarest of California "horny toads" has the habit of remaining completely motionless in the presence of danger. This habit is fully justified by the perfection of the lizard's concealment under or beside any little wisp of cover or even in the speckled shadows cast by creosote bushes. This "horned toad" is one of two or three species of lizards that feeds voraciously on the fiery-

▲ LATE RISER: a sidewinder basking in a depression it made for itself. The rising sun will soon force it to seek shade under a shrub or in a rodent burrow

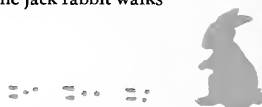
stinged agricultural ants. It is notable that both prey and predator seem to exercise a considerable degree of mutual respect. When the lizard is lying near the burrows of the ants, they remain below the surface, appearing only from time to time, with their actively moving antennae just protruding at the entrance of their nest. Since the lizard has been observed eating as many as 60 of these rather large ants at one sitting, the wariness of the ants is not surprising. On the other hand, if the lizard happens to be lying near the nest when it is broken open, the excited occupants swarm out onto its body, and it beats a hasty retreat. This seems to indicate that the lizard escapes being painfully stung only when it is the aggressor.

One of the more interesting lizards, the velvet-skinned fringe-footed lizard, or *Uma*, is caught by





◀ COTTONTAIL RABBITS move both hind feet at once to form tracks like these, whereas the jack rabbit walks or runs



a variety of techniques, the choice of which depends mainly on the time of year or time of day. In April, May, or early June, one of the more successful methods is to walk along the steep leeward faces of the larger sand hills. Here the soil lies at a sharp angle of rest, and any slight disturbance on or just below the surface sends a rivulet of sand flowing down the steep slope. The resulting scars on an otherwise unmarred surface usually represent a night resting place and an early morning stirring of the lizard. If you grasp a handful of sand at the apex of the slide area, you will often find yourself in possession of one of these exquisite reptiles. But a word of caution is needed, for the venomous little sidewinder rattlesnake is also in the habit of concealing itself underneath the sand. So far, we have found no sidewinders hidden in these leeward faces of the dunes, and probably none will be found on such a steep slope; nevertheless, caution is suggested.

The fringe-footed lizard is among the more dune-adapted of our lizards. Its flattened body and smooth surface texture seem to permit expert diving into and under the sand. The feet are fringed with rows of valvular scales, arranged so as to facilitate pushing movements or "swimming" beneath the sand. The problem of sand or dust getting into their eyes, nostrils, and ears

is adequately solved by intricate eyelids, valvular nostrils, and by moisture in the nasal passages which helps to collect and discharge extraneous particles. Also, there is provision for ample moisture around the eyes. Finally there are ejecting mechanisms, which eliminate any dust that may have passed the previous defenses.

This fascinating lizard is so beautifully matched to its background of open sand, or for concealment under creosote bushes, that one has difficulty discovering it. Even when seen, its agility and its sudden dives under the sand make it extremely elusive. However, a close examination of these reptiles is worth the effort of capturing one, for in the hand they are astonishingly attractive, especially in the springtime when the postnuptial color shows as an almost orange-vermilion wash on an otherwise snow-white under-surface. On the back, the spotted or ocellated pattern, which originally gave the animal its name of ocellated sand lizard, is made up of tiny dark maroon or almost black spots.

Close examination of the head reveals an organ so like an eye that it is often referred to as the third or pineal eye. This structure is located on top of the head, behind the true eyes. It so closely resembles a real eye, with pupil, iris, and curved lenslike covering, that you might suppose it must have

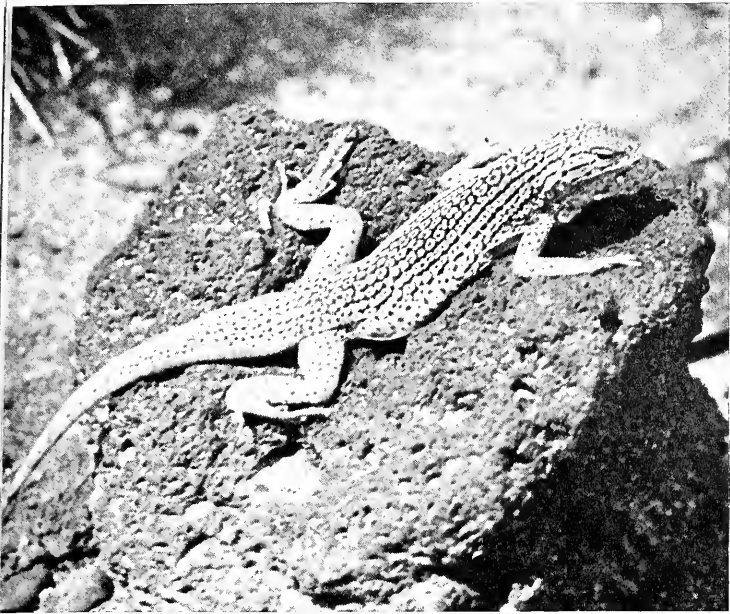
some real function. But if there is a use for the "eye," it has not been demonstrated, although there does seem to be a possibility that it may function in regulating the temperature of the brain. This is now only a hunch with no direct evidence to support it. Several other species of lizards with somewhat similar habits have nearly as conspicuous pineal structures. In any event, whether the "eye" is useful or not, the fringe-footed lizards are among the most numerous occupants of the sand dunes, and their abundance indicates a high degree of success.

Along the ridges where the views are best and where the sun's first rays warm up the sand, these lizards find a situation that seems especially attractive to them, at least during the early morning and late afternoon. However, it is along these same ridges that one finds the "Maltese cross" tracks of one of their most active enemies—the lizard-eating ground cuckoo or road runner. These active birds forage along the crests of the ridges, and you may be able to follow their tracks for many hundreds of yards. These excursions are probably productive as a rule, for they seem to represent a regular habit, and the most abundant supply of potential food consists of these beautiful little lizards.

Although no longer common, the badger also makes excursions in these dunes; but its activities are chiefly confined to the night hours when, according to information gleaned from their tracks, they "nose" along, sniffing at likely places and occasionally finding a sleeping fringe-foot.

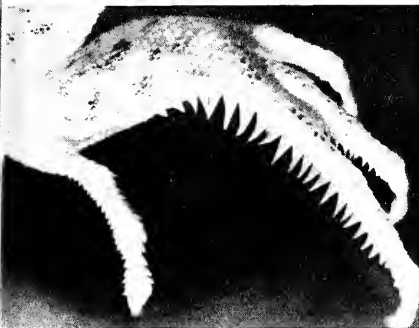
Collecting and tracking daytime animals is especially difficult in the evening because of the confusion that results from the day's accumu-



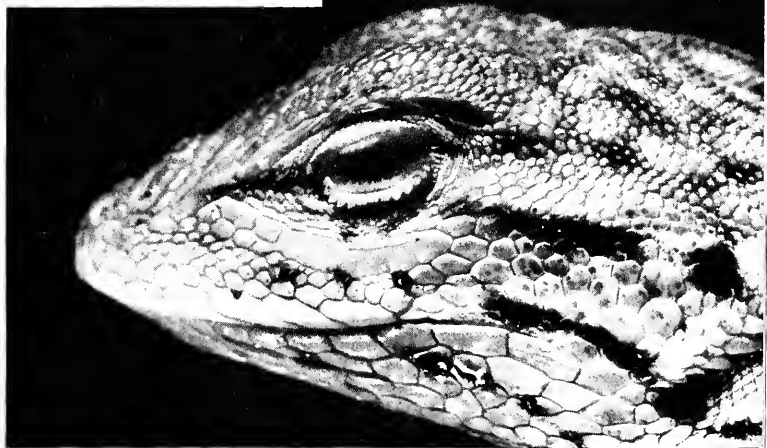


◀ THE FRINGE-FOOTED LIZARD, with flattened body and beautiful, smooth skin, is well equipped for diving into and under the sand

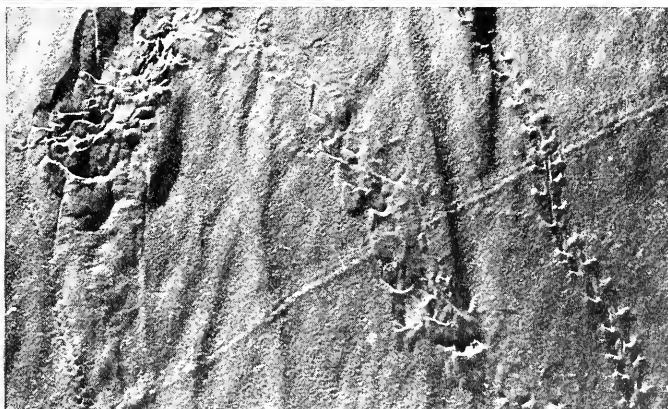
▼ PROTECTIVE SCALES above and below the eye and a double, dustproof fringe on the eyelids help protect the wedge-shaped head of fringe-foot



▲ ITS FRINGED FEET enable it to "swim" under the sand, thus baffling the hungry pursuer and the student of tracks



➤ AT UPPER LEFT, a fringe-footed lizard enjoyed an early morning sun bath, then proceeded in a leisurely fashion to lower right. It then moved back toward upper right. The diagonal tracks are those of a beetle



lation of tracks. The scurrying activities of round-tailed ground squirrels, lizards, and a host of insects clutter the surface and make it almost impossible to follow any one trail to its conclusion. Sometimes a similar situation is encountered in the morning. Fortunately, the very conditions that create the dunes also supply a remedy in the form of frequent windy nights that erase all previous tracks and leave a smooth "slate."

By taking temperatures at critical times, much can be learned concerning the maximum and minimum temperatures acceptable to nocturnal animals and the approximate time of their activities. Eventually, it should be possible to accumulate valuable information on the extent of their nightly movements, both during and after the mating season, and also the degree of population mixture and other facts of general biological importance.

Observations are especially significant whenever the usual evening winds have been brief. One of the more interesting animals of which you may find evidence is the little spade-nosed snake, *Chionactis*. This small serpent makes almost perfectly symmetrical trails of sinuous lines, a smoothly flowing succession of continuous "S" tracks that start from under one bush or hummock and pass to another.

As in all snake tracks, the piling up of a faint accumulation of sand *behind* the loops indicates that the snake was moving away from those portions of the curve. In spite of this easy guide to where it went, it is almost impossible to catch these snakes in the daytime. Only twice in hundreds of trips have we observed them on the surface during daylight hours, although at night, while driving along dark asphalt highways on the deserts, they are not uncommonly collected. These harmless little snakes, a foot or so in length, include in their diet insects and other arthropods, even to fairly large and powerful scorpions. In the laboratory they feed on centipedes, and even these seem of formidable size for them.

Among other interesting tracks are the slanting "ladder-rung" trails of the sidewinder rattlesnakes. These are totally unlike the tracks of any other native snake, and for years the mystery of exactly how they were made baffled naturalists and laymen alike. Many hours of careful observation of the moving snake, and of the tracks it leaves behind, failed to elucidate completely the problems of its locomotion.

One scientist, a man more ingenious and with deeper insight than his predecessors, visualized the movements as those of a flattened, rolling helix, a one-and-a-half spiral. The little rattlers flow smoothly sideways, hence their colloquial name. That there is a rolling motion is shown clearly in the imprint of the belly scales, which form transverse, treadlike lines. No sliding movement could leave such imprints, any more than a skidding tire could leave its tread marks.

Slow-motion pictures show in detail the sidwinding locomotion. But a simpler way is merely to put the snake into a refrigerator until it is chilled into slow motion. For purposes of study, this is as effective as the slow motion brought about by the use of moving pictures and trick photography. For those who have access to the snakes and are possessed of a desire to study this method of progression, a chilled sidewinder serves the purpose admirably.

In its native habitat, of course, the sidewinder does not venture abroad when air temperatures are much below 65 degrees F. Chilled sidewinders are rarely encountered in nature and for very good reasons. Like all other reptiles, cold reduces them to helpless torpor, and they become easy victims for any active carnivore.

Thus the cold wind that howled around our sleeping bags was a source of comfort to the timid members of the class. It meant that no sidewinders were abroad so late that night. Yet the following morning when the wind had subsided and the morning sun began to heat the substratum, many of the ani-

mals buried under its protective covering resumed normal activity.

Meanwhile, at the crack of dawn, the class was at work reading the evanescent record of night life on the desert. Here was the depression left by a sidewinder when he paused as the temperature dropped. Sand carried by the cold night winds had drifted over the snake, but he had vacated the spot when the morning sun raised his body temperature to the point where he could seek the shelter required to avoid the midday heat. Some fringe-footed lizards were already abroad, but the more observing members of the class spotted some telltale scars on shaded parts of the dunes and readily captured the still torpid saurians.

Round-tailed ground squirrels and the whiptail lizard soon began to swarm over the sandy surface, obscuring the record. And yet if time were taken, each member of the class could read the record and draw reliable inferences before the pattern was cluttered or erased by the winds of the following evening.

Sandstorms may occur at any time, but they become less frequent toward the end of spring. Late April, May, and October, with their cold nights and often hot days, are probably the ideal months in which to visit the desert. These months, and also June, are certainly among the best, if the student of reptile life hopes to see all that the region offers—and the desert at its prime is unsurpassed.

For observations on birds and mammals, unless special studies are contemplated, the winter months are most comfortable; but those who plan to camp should recall the words of the familiar song and remember that the sands of the desert do grow cold and that snow and ice are not unknown—even in the famous town of Palm Springs. Tracks in the snow are interesting, too, but they are likely to be confined to animals provided with internal heat—the birds and mammals. Most reptiles, including the snakes, will already have retired for their months-long winter rest.



▲ OVERLOOKING a pool frequented by a wide variety of African animals, Treetops offers the naturalist or wildlife photographer a unique opportunity. It is located almost on the equator in the interior of Africa, but electric lights, running water, and full-course meals make this one of the world's most remarkable hotels

THE past few years have changed the character of much of Africa, and the little town of Nyeri, which lies in the upper reaches of the Tana River valley between the towering, snow-clad peaks of Mt. Kenya and the magnificent forests of the Aberdare Range, clearly illustrates this. Not many years ago great herds of game roamed where Nyeri now stands. Today, in the center of a prosperous agricultural region, it is a holiday resort, proud of its excellent hotels, golf course, tennis courts, pleasant homes, and beautiful gardens. And yet, despite these new developments the surrounding country has changed less than one might imagine. A friend who drove in to see us from his farm only a

# "TREETOPS"

From a unique inn tucked high in the branches of a wild fig tree, a panorama of African wildlife can be observed while you enjoy the comforts of home

By LT. COL. and MRS. WILLIAM J. MORDEN

*Leaders of the Morden African Expedition of the  
American Museum of Natural History*

*Photographs by the Morden African Expedition*

few miles distant did not feel free to remain for dinner. In driving home after dark, he explained, there was too much likelihood of meeting elephants or rhinos on the road, for among the forests on the near-by mountain slopes the animals still range almost as freely as they ever did.

Our reason for visiting Nyeri was not only to enjoy the comforts of the delightful Outspan Hotel or the attractions of the town. We

were on our way to a simpler but much more remarkable inn that lies a few miles away in the forest—a unique hostelry containing only four rooms, which is built high among the branches of a huge wild fig tree beside a forest pool. It is appropriately called "Treetops." In reality, this strange inn is a kind of glorified observation post from which to watch the animals that come nightly—especially during the full moon—to drink and wallow in

**ELEPHANT  
IN FOREST  
GO SLOW  
AT NIGHT**

▲ EN ROUTE to Treetops, signs remind the traveler that he is not among tame animals

the pool. It is a surprise to have electric lights, running water, and excellent food while observing the nightly movements of a wide variety of wild animals.

The idea was conceived by Eric Sherbrooke Walker and his wife when numerous visitors to this part of Africa wanted to see more big game than was easy to guarantee on the usual trips into the forest. Also it was rather risky on the ground. Several times a party unexpectedly encountered a rhino too close for comfort. Mr. Walker had, in his youth, been a lover of Barry's play *Peter Pan*, and he and his wife conceived the idea of a hotel in a tree. After many expeditions into the forest, he at last found the ideal place—an enormous tree, on the downwind side of an open glade frequented by all the animals, with a pool in the middle. To make the pool more to the animals' liking, he added salt.

Treetops is open to visitors only during the full moon, and we had to make reservations several weeks in advance. Shortly after noon, we

► AT INTERVALS along the trail to Treetops, ladder rungs are nailed to the trees to provide ready escape in case of attack

entered the station wagon to drive the six or seven miles from Nyeri toward Treetops. In addition to the driver and several porters with boxes of food and supplies, there was the Assistant Manager of the Outspan Hotel, who was to act as general factotum, and a so-called "white hunter" carrying a heavy double rifle. It was his duty to escort us in safety to our quarters in the tree. Having traveled among big game in various parts of Africa during the preceding months, we were unimpressed with the importance of this precaution. We had been advised not to bring our own heavy rifles, because there is no shooting here except for self-protection, as in some other sections of Kenya Colony and elsewhere in Africa. In fact, there is a definite trend today toward big game photography instead of big game shooting.

We soon learned that no road led directly to our destination. The last half mile or so of the way was nothing more than a winding path through thick forest and dense bush, along which we had to make our way on foot. Also, we gained a new understanding of that last half mile when we saw that almost every reasonably sturdy tree along the trail had crossbars nailed, ladder fashion, to its trunk, up which one could make a quick getaway if elephants, rhinos, or buffaloes made that seem like a good idea.

We didn't linger on that trail, and after an uphill climb we reached a little glade and caught our first glimpse of Treetops. Di-

rectly beside a glassy pool a few hundred feet in diameter stood the huge fig tree, its massive trunk 5 or 6 feet thick, with several great branches standing boldly out at a height of 30 or 40 feet. Among these branches was Treetops.

As inns go, it was, of course, small. Yet high in that immense tree, it did not seem so. We spent little time observing it from the ground, for the forest pressed in close on every side and animals, we were told, would soon be coming to the pool. Naturally, we wanted to be topside to see and photograph whatever came while daylight lasted.

By way of a narrow ladder we began our climb into the tree; but shortly the ladder led to a flight of steps which, winding back and forth, took us ultimately to this treetop bungalow. The Assistant Manager and two "boys" accompanied us, and some supplies were sent up. The white hunter then turned back with the other porters to return to Nyeri. Even before they had disappeared along the trail, the ladder that formed the lower section of our way into the tree was hauled up among the branches and made fast, leaving us safely cut off from the ground. The trunk of the tree itself was heavily wrapped with barbed wire to keep leopards and other climbing predators away.

The house in which we found ourselves was what every child has dreamed of—a fairy tale place come to life. It was ideally designed for its purpose and, to our surprise,

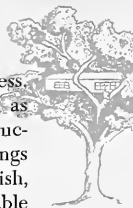


remarkably sturdy and motionless. There was no quiver, no shake, as one might expect in such a structure. And though its furnishings were rustic and far from lavish, everything was most comfortable and complete.

A living room that may have measured about twelve by fifteen feet was carpeted with rugs and contained a long table, together with benches, chairs, and a desk upon which lay a huge guest book. Here, previous visitors had described their experiences in great detail, sometimes even with sketches and verse. There was a full-sized double bedroom and a smaller one with a cot in addition to a bed. The kitchenette contained a stove which was later to become welcome, not only for the meals it made possible but also because as night fell the air turned sharply chill. Two toilets and a separate shower bath completed the interior arrangements. Outside, for the observation of wildlife, was an open balcony on which we immediately set up our motion picture camera. Somewhat higher up in the tree a little platform had been built to make possible a view across the surrounding countryside.

For some time after our arrival no animals appeared. However, the sun was still high when, from the small upper platform, we plainly saw two elephants in an open spot in the near distance, feeding on the branches of small trees. And the light was still good enough to take some motion pictures in color when a handsome waterbuck put in his appearance not far away at the edge of the pool. A doe appeared as well, and a cinnamon-colored bushbuck soon followed. None of them paid any attention to us in the tree. As the sun was setting, four giant forest hogs with four piglets cautiously approached the water, stood there for a bit, and then disappeared silently into the forest. A little later we caught a glimpse of a spotted hyena as he looked hopefully about.

A family of hornbills had their nest in the fig tree and, having long since accustomed themselves to



MANY famous personages have climbed this ladder to sign the register in Treetops. The ladder is pulled up at night for safety against prowling animals. The trunk of the tree is wrapped in barbed wire

their strange neighbors, unhesitatingly came to the living room window and looked in. Down at the edge of the pool other birds were numerous. As the sun slipped below the horizon and the pool grew dim in the shadows, the whole vicinity was peaceful, with nothing to suggest how many animals were in the surrounding forest.

We were attended in our aerial hotel only by the Assistant Manager and the two native boys, but they formed an entirely competent staff. At the appropriate moment, we were served what British Africa universally calls a "sundowner," followed by a really delicious four-course dinner, served amid such amenities as could never have been expected in such a place. The rooms were adequately lighted by electricity, the source being two automobile-type storage batteries; and on the balcony was mounted a strong electric searchlight, ready to be directed at such nocturnal visitors as might appear.

The stage was certainly well set, but to our disappointment the evening was quiet. The air grew colder, and we began to appreciate the heat of the stove, even though we were within a degree of the equator. Toward midnight, we gathered around its friendly warmth for hot chocolate. Then, since no wild visitors of consequence had appeared, we decided to take a nap. But before this plan materialized, the silence was suddenly broken by a series of prodigious snorts that seemed to come from directly below us.

Here was what we wanted!

We hurried to the balcony and, peering over, saw beneath us a mother rhino and her very small "toto," or baby, while another rhino—larger and probably a male—was



snorting, stamping, and moving about a short distance off.

We had not heard them approach, nor had they apparently heard each other until they were close. No sooner had they become aware of each other than they began snorting energetically. They made all sorts of strange noises and shuffled back and forth, each plainly doubtful of the other but not quite willing to settle the matter with a charge.

We flashed the searchlight on them, drawing their attention momentarily, but when the light went out, they resumed their snorts, squeals, and tramlings. Finally, however, they suspended their argument and disappeared into the forest, leaving us surrounded once more with the moonlit silence.

Again we lay down on our beds, but shortly we were roused and brought to the balcony by a new racket below. This time it was a great splashing; and in the light of the moon, which was now well overhead, we could see a big buffalo wallowing noisily in the shallows below us. When the searchlight was turned on him, he lifted his great head and stared upward, but the moment the light was off

*Continued on page 240*





▲ SANTA ELENA CANYON, near the Park's westernmost boundary, with Mexico on one side, the United States on the other. It was at this spot that smugglers and bad men used to slip back and forth across the border

**B**IG BEND National Park derives its name from the fact that the Rio Grande River, separating the United States and Mexico, makes a huge U-shaped bend in this region. The Park's most magnificent attraction is Santa Elena Canyon, a 1500-foot cleft through which the river flows.

It is said that everything in Texas is big. The Park contains over 1000 square miles and is located in the biggest county in the biggest state. In it has been found the largest known fossil tree (14 feet in diameter) and the largest prehistoric crocodile (approximately 45 feet long). Remains of this creature are

on display at the American Museum of Natural History. Dr. Barnum Brown, the well-known dinosaur hunter, discovered this huge animal in 1940. It lived some 70 million years ago and was almost half again as long as the largest living crocodile. Some of its teeth were five and six inches long. Lush semitropical vegetation covered the Big Bend when the giant crocodile lived there.\*

The Big Bend has attracted numerous other scientific investigators. Significant discoveries have been made there by the Chicago Museum of Natural History, among

\* See NATURAL HISTORY for May, 1942.

A region rich in the remains of prehistoric animals and entrancing in its spacious scenic grandeur

By SIDNEY ROSS

Photographs by Ross-Pix

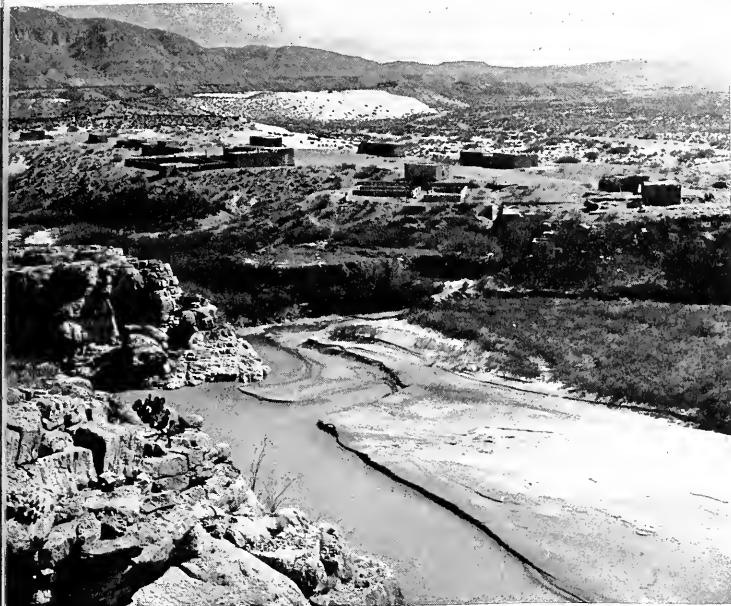
# BIG NATION

others, particularly in the types of mammals that lived 30 to 40 million years ago.

In few other localities can be found as magnificent and rugged a combination of mountain, desert, and river valley. Its mountains, while by no means the tallest or most impressive in the United States, have a special brooding majesty, which causes the visitor from one of the crowded centers of civilization to feel small and humble. Its deserts present tortured vistas of sand and rock, with interesting types of plants growing amid the geological curiosities. Over all

NATURAL HISTORY, MAY, 1949





◀ THE TINY Mexican village of Bouquillas, just across the Rio Grande, dozes in the sun. Its dozen or so families and as many dogs constitute the largest Mexican town bordering the entire Big Bend National Park area

▼ OLDEST "RESIDENT" of Big Bend National Park is 107-year-old Gilberto Luna. The ancient Mexican has lived in this region for almost 75 years, and the Government is allowing him to pass his remaining days here. Spry and alert, he makes a living by herding goats and raising corn and chickens



# BIG BEND NATIONAL PARK

of this sparsely settled region hangs a great silence.

The climate of the Big Bend is attractive to those who prefer to avoid extremes. The mountains that ring the location protect it against high winds, and the dry desert atmosphere is generally mild and bracing. Even in summer, the thermometer rarely zooms up to the point where it is unbearable.

Visitors to this Park will find not only all manner of scenic grandeur but also human beings who are every bit as fascinating. Everyone in Big Bend is a personality, from Mrs. Maggie Smith, who runs

a combination post office, general store, and primitive health resort, to "river rider" Aaron Green, nicknamed "Noisy" because he was once heard to utter as many as ten words inside of one week. Or perhaps the visitor will want to stop and exchange greetings with 107-year-old Gilberto Luna and his 40-odd grandchildren, or toss off a cold drink with affable Polk Hinson, who presides over a store at the ghost mining community of Study Butte.

Once you come to Big Bend, the rest of the world becomes unreal. Mail comes and goes only once a week, and you don't feel like writing or receiving letters. As you explore this fabled territory, which has been seen by Spanish conquistadores, Mexicans, Apaches, Comanches, cattle rustlers, smugglers, and bad men, the outside world becomes unreal, and you feel yourself slipping under the spell of a land that has witnessed the measureless march of time.



▲ SOME IMAGINE it a lifelike serpent with fangs bared. "Rattlesnake Rock" was said by the Indians to have been set up by the Creator to guard Big Bend from intruders



◀ ATTRACTIVE HOUSEKEEPING CABINS like this one offer comfortable lodging, with kitchen facilities, bathroom, and shower. All were built by CCC boys. But tourist facilities are still inadequate, so write well in advance. You can't phone or wire in the Big Bend

► WILDLY PICTURESQUE Green Gulch Canyon presents a breath-taking panorama of loveliness the year round. Deer and mountain sheep can be seen in the region



◀ RIVER RIDER "Noisy" Aaron Green, whose combined business and social conversation may total ten words a week. As Agent for the Department of Agriculture's Bureau of Animal Industry, he guards the border against the incursion of cattle that may have hoof and mouth disease

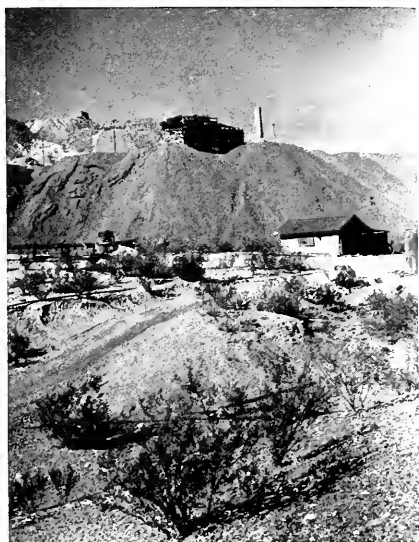
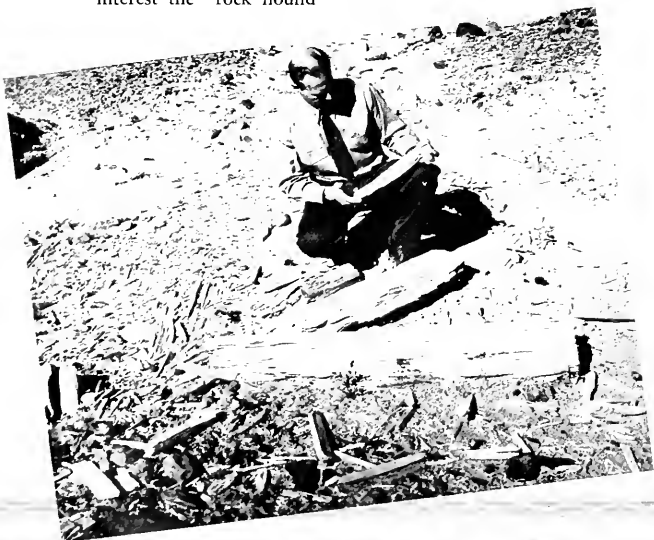
► WEIRD FORMATIONS like toadstools dot the desert landscape near Terlingua





▲ NEAR BOUQUILLAS CANYON, the turgid Rio Grande divides into three channels, and one can easily wade across the border

▼ BIG BEND RANGER Harold F. Schaafsma, examining a petrified log in the Terlingua area. The log looks like a piece of ordinary wood, but try to lift it! The Big Bend area has produced the largest known petrified tree, measuring fourteen feet in diameter, and there are various semiprecious stones to interest the "rock hound"



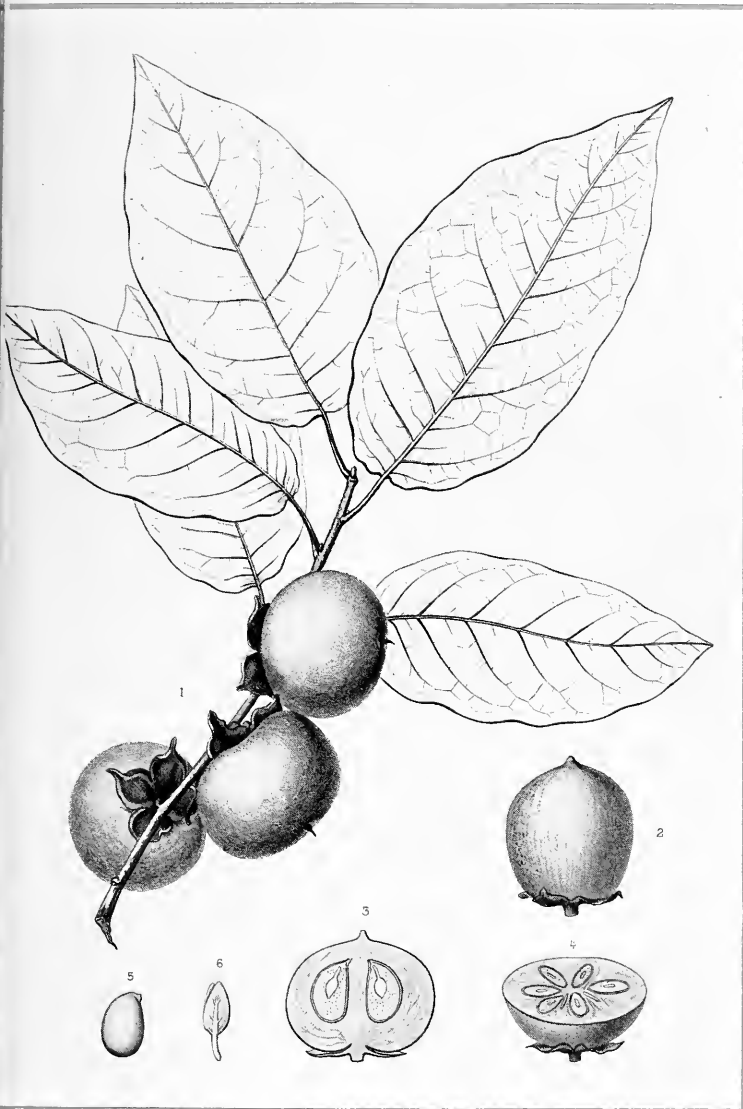
▲ THE GHOST TOWN of Study Butte was once a thriving community. Its quicksilver mines once produced 365 days in the year. Now it is almost deserted, with three permanent residents and a general store that is facetiously called "The Night Club" by Big Bend people

"IF it be not ripe," said doughty Captain John Smith, of the persimmon he first tasted near Jamestown, "it will draw a man's mouth awrie with much torment." And your own first bite into a persimmon fruit, unless you have been brought up in the region where it is a familiar article of diet, is almost certain to be an unforgettable

# The Persimmon

Its wood, if seasoned, ranks among the hardest and most specialized in use; the fruit, if ripe, is among our softest and most delicious

By DONALD CULROSS PEATTIE



By Charles Edward Faxon, from Sargent's *Silva of North America*

experience. It will be a day before you can get the puckery taste out of your mouth, and in all probability you will be disposed never to make another trial of the fruit whose name, *Diospyros*, means "Food of the Gods." But that is because most people attempt persimmons before they are truly ripe. At first green, then amber, a persimmon is not ripe until the skin is deep orange, wrinkled, and unappetizing in appearance, and the pulp is so mushy that one cannot eat it without washing the hands afterwards. That stage comes, most commonly, after the fruit has been frostbitten and then warmed by the sun of Indian summer.

Close relative of the kaki or Japanese persimmon, our native fruit is not so large or handsome or firm of flesh. Yet it is esteemed by connoisseurs, who will travel miles to gather the fruit of a particularly fine tree, and they tell you that the art of eating a persimmon consists (in addition to persuading one's self that a fruit may be a perfect mush and yet delicious) in avoiding the skin altogether, for the intensely tannic taste never leaves that part of the fruit. Certain it is that some trees produce large, some small fruit; some fruits are delicious, some never good at any season; some ripen in August, some in December, and others hold their fruit until spring. Obviously, amidst such variation there are strains well worth propagating and breeding.

During the Civil War, when Confederate soldiers boiled persimmon seeds as a substitute for coffee, Prof. F. P. Porcher published in Richmond a book, *Resources of the Southern Fields and Forests*, intended to show the way to meet the blockade of rebel seaports by

▲ THE FRUIT is "exceedingly austere while green," wrote the celebrated botanist Charles Sprague Sargent, "but luscious when fully ripe"





▼ THE FRUITS are not so large as the Japanese persimmon, but devotees are reluctant to yield honors in flavor

L. W. Brownell photo



◀ A PERSIMMON TREE at the University of Maryland, bare after yielding the fruit that has made it cherished there

▼ THE CORKY-LOOKING BARK of the persimmon is easily confused with that of the black gum

Arthur C. Parsons photos



utilizing the native products. In this book he gives as a recipe for persimmon syrup the following:

"The persimmons are mixed with wheat bran, baked in pones, next crushed and put in vessels, water poured on, and all allowed to stand twelve hours. Strain and boil to the consistency of molasses." Porcher adds: "A good vinegar very much like and equal to white wine vinegar is made as follows: Three bushels of ripe persimmons, three gallons of whiskey, and twenty-seven gallons of water. To those who can get the persimmons, the vinegar thus produced will be relatively

cheap, even at any price which the elastic conscience can ask for the spirits"—a thrust at war profiteers.

Professor Milton Hopkins<sup>1</sup> tells us how to make a persimmon pudding:

"Three eggs, ½ teaspoon salt, 2 cups sweet milk, 3½ cups flour, 1 qt. seed persimmon fruits, 1 pint cold water, 1 teaspoon soda, 1 cup granulated sugar.

"Wash and seed the fruit (to make 1 quart, about 3 quarts of whole fresh fruit required) and soak them in cold water for about

<sup>1</sup>"Wild Plants Used in Cookery," New York Botanical Garden Journal, vol. 43, pages 71-76, 1942.

an hour. Then run them through a colander. Mix the other ingredients in the order given stirring thoroughly. Pour the batter into a greased pan and bake at 400° for one hour or until the pudding is a dark brown in color. Serve either hot or cold with whipped cream or hard sauce, and garnish with maraschino cherries. The pudding keeps well in the icebox for several days."

Naturally, persimmons were an important article of diet among the Indians. De Soto was offered loaves made of persimmons by the Indians in the neighborhood of Memphis, and he discovered dried persimmons (called prunes in the narrative) in the villages deserted before his warlike advance in Arkansas. The English naturalist John Bradbury, while traveling up the Missouri, was received among the Osages and offered a bread called *staninca*, made of the pulp of persimmon pounded with maize; he described the taste as like gingerbread.

Le Page de Pratz in 1758 wrote, in his *History of Louisiana*, of the persimmon or *placiminier* of the Creoles that: "When it is quite ripe the natives make bread of it, which they keep from year to year; and the bread has this remarkable property that it will stop the most violent looseness or dysentery; therefore it ought to be used with caution, and only after physic. The natives, in order to make this bread, squeeze the fruit over fine sieves to separate the pulp from the skin and the kernels. Of this pulp, which is like paste or thick pap, they make cakes about a foot and a half long, a foot broad, and a finger's breadth in thickness: these they dry in an oven, upon gridirons, or else in the sun; which last method of drying gives a greater relish to the bread. This is one of their articles of traffic with the French."

But no matter how we humans improve the breed, or cook the fruit, the persimmon will never mean to us what it does in the lives of the wild animals. It is eaten by birds, notably the beloved bobwhite, by the half-wild hogs that rule the Ozarks, by flying squirrels



and foxes, by raccoons and skunks and white-tailed deer, and above all by the opossum. According to song and story, most 'possum hunts end at the foot of a 'simmon tree, and when Audubon came to paint his great picture of the opossums, he showed them devouring the strange, puckery-looking fruits, high in the branches of this grand old tree.

Anyone can name a persimmon when it is in fruit; but in its winter nakedness or its heavy summer greenery with those dark, gleaming, tropical-looking leaves, the tree is not so easy to identify. From its leaves, it is apt to be confused with the black gum, and both trees have deeply furrowed and cross-checked bark. But black gum bark has rather regular narrow ridges cut by remote cross checks, while the bark of the persimmon is irregularly broken into countless small blocks; it has a distinctly reptilian sort of corky hide. In winter, the naked persimmon is revealed as a not very graceful tree, with short crooked branches and fine crooked twigs; and in autumn, the leaves fall very late in the season without turning the gorgeous colors of the black gum. But in the first hot weather of summer the flowers appear, and all that is tropical-seeming about this member of a very tropical family is expressed in the blossoms. True, the waxy-white flowers do not make a brilliant show (they are too small for that and are overtopped by the foliage); but they breathe forth from their thick, jug-shaped corollas a heavy perfume that is the very spirit of the southern summer.

The persimmon often forms dense thickets on dry, eroded slopes. Not only has the tree a deep taproot, but it sends out long stolons or subterranean runners, which are both wide-spreading and deeply penetrating. Trees grown from stolons, however, are apt to be shrubby and are very difficult to eradicate once they have penetrated the soil of an abandoned field. The finest trees, from the point of view of wood production, are, or were, those growing under primeval for-

est conditions where competition with other trees has forced them to their maximum growth of 100 or even 130 feet in height. Of course the fruit on such a tree is unhandy to pick, and the gatherer of persimmons greatly prefers the dense bushy thickets that spring up on the sides of gullies and in old fields. Although not a fast-growing tree, the persimmon begins sometimes to bear fruit at an early age. It succeeds in the most adverse sites—on the coal lands of Illinois stripped of all the topsoil, or in bottom lands where the water may stand for several months. A more adaptable tree would be hard to find, and the extent to which it is cherished in southern farmyards would make one think it common. Actually it seldom occurs in pure stands, and as soon as the lumberman tries to find specimens suitable for cutting, he discovers that, wide though the range of this species, it is not individually so very numerous.

Persimmon belongs to the same genus as ebony (*Diospyros Ebenum*) of the Orient and betrays the relationship in its heartwood, so dark a brown as to be nearly black. This, however, sometimes does not develop until the tree is over a century old; the very thick sapwood is a pale brown. Persimmon belongs in the class of the very strong woods and is surpassed in our sylvia only by honey locust and black locust. When green, it is not so very hard, but no other wood gains more in hardness when it is well seasoned; it falls in the class of the extremely hard woods, as hard as mountain laurel and surpassed only by ironwood and dogwood among the woods of our northeastern states. In weight it is in the very heavy class. It shrinks greatly in drying and will crack unless the ends are protected by paint or parafin. Difficult to glue, it is never used in built-up or ply or fabricated wood; but when once seasoned properly, it retains its shape to perfection. The more it is used the higher and glossier its polish.

Because the trunk is seldom more

than a foot in diameter, this tree can never be an article of great commerce, in spite of its valuable properties and the good price it fetches. Its strength as a beam cannot be utilized because of the rarity of dimension timber; indeed, persimmon is commonly sold by the cord. Almost all woods of any value find special employment for which their properties fit them uniquely, and so because of the hardness, smoothness, and non-warping qualities of persimmon, its chief use is for the making of shuttles for textile looms. Some woods, valuable in many other ways, cannot endure an hour under the terrific wear of the looms without cracking, splitting, or wearing rough; persimmon, like apple and dogwood, can endure 1000 hours of furious activity in the mills. Because it stands wear so well, it is employed in the lasts of children's shoes, but it is too expensive for use in shoes of adults whose styles in footwear change often. The heartwood has been used extensively for the heads of golf clubs because it does not crack under a sudden or impact load and takes such a high polish. It is used for billiard cues and beautiful parquet flooring, and in earlier days spinning wheels were made of persimmon wood in the South.

The name of persimmon is old; the Lenape Indians, with whom William Penn treated, called it *pasimenan*. But older still is the geologic ancestry of this tree. Fifty-five million years ago, when the ancestors of the horse were small and short-legged as ponies, persimmons of numerous species were widespread in North America. What is now the ranch country of western Oregon, for instance, supported an extinct species (*Diospyros oregana*) whose closest living relatives are now in Java. But many changes in altitude and climate have swept the ancient persimmons from the West, and today this single species, within the circumscriptions of our northern sylvia, lives on, as much a reminder of a far-off time as the opossum, our only remaining marsupial.



▲ TWENTY CARIBOU crossing a rapid on Little River. A typical Barren Grounds ridge lies beyond, with dwarf birch thickets and small black spruces scattered over its slopes

# In Caribou Land

Exploration in one of the least-known sections of Canada, where the timber meets the tundra

By FRANCIS HARPER

*Photographs by the author*

FIRSTHAND acquaintance with the Barren Grounds of northern Canada and their foremost animal denizens, the caribou, had been one of my most cherished objectives for nearly 40 years. Meanwhile, I had pored over the accounts of these animals by such explorers and naturalists as Samuel Hearne, Sir John Richardson, the Tyrrell brothers, Buffalo Jones, Warburton Pike, David T. Hanbury, Edward A. Preble, and Ernest Thompson Seton. At the same time my attention was becoming strongly focused on Nuel-tin Lake, lying across the Keewatin-Manitoba boundary. This hundred-mile-long lake had been crossed in 1770-71 by the intrepid Hearne, but it had remained unvisited by any

professional biologist during the ensuing century and three-quarters. Even on the latest official maps it was represented merely by broken lines. For an average distance of some 200 miles in nearly every direction there extended, until very recently, a general vacuum in biological information—north to Yath-kyed Lake and the Thelon River, west to Lake Athabaska, south to Reindeer Lake, and east to Hudson Bay.

A presentation of this state of affairs to the Arctic Institute of North America led to a grant-in-aid from that organization, with support from the Office of Naval Research.\*

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The way was finally clear to Nuel-tin Lake and its caribou. When I arrived at Churchill in the latter part of May, 1947, the backward season still offered a chance for a plane to utilize the frozen lakes as ready-made airfields. Eaves-high snow-drifts and wintry blasts seemed to say that spring was far behind. An Army bulldozer cleared a way through the drifts, and on the last day of the month our twin-engined Anson took off, with Johnny Bour-assa in the pilot's seat.

The entire route to Nuel-tin Lake, 250 miles to the northwest, was over a varying mixture of tundra and patches of small spruce and tamarack—an unbroken wilderness save for the Hudson's Bay Company post

at Duck Lake, where we were to stop briefly for refueling. Under Johnny Bourassa's skillful navigation we made the post "right on the beam" and landed nicely. Caribou-eater Chipewyans promptly hitched up a dogteam and hauled several drums of gas from the warehouse. Beyond this point it was altogether new territory for the plane's crew. Our problem was to locate the little Windy River trading post at the northwestern extremity of Nueltin Lake—a veritable needle in a haystack. Toward the end our course might have been likened to that of a mariner seeking a haven on an unknown coast. Close to the Magnetic Pole the compass becomes uncertain, and even the most seasoned pilots seem to have exceptional difficulty in finding their way over the Nueltin area. When we arrived over what appeared to be the northeastern arm of the lake, it was difficult to distinguish between the snow of its frozen surface and that of the surrounding tundra. We were seek-

ing a range of hills on the south side of Windy Bay, which we hoped would guide us to the cluster of log cabins belonging to the Schweder brothers. When the search was beginning to look more and more dubious, Johnny made a sudden turn, and a few minutes later we saw a small tower rising from a group of cabins half hidden in snowdrifts at the mouth of Windy River. He brought the plane down on the bumpy surface of the near-by bay, and we reached the camp to find it silent and unoccupied.

In Churchill I had received an invitation to make this camp my headquarters for the season. It was being maintained as a trapping center and trading post by two brothers, 22-year-old Charles Schweder and 17-year-old Fred. Their nearest neighbors and principal customers are a small group of Padlimiut Eskimos, whose camps are on or near the Kazan River some 60 miles to the northwest. They also do a little trading with some caribou-eater Chipe-

wyans who live about the south end of Nueltin Lake. They themselves derive sturdy qualities from Cree forebears.

In late afternoon the plane took off for Churchill. Then began a several days' task of portaging outfit and provisions over a rugged quarter-mile to the camp. Meanwhile, I set up a skinning table beneath a little window in the three-room log cabin and by degrees got into the swing of the season's biological operations in a marvelously fascinating environment.

On the third day the door opened softly behind me, and there stood a six-foot-three, 190-pound giant looking upon me with some wonderment in his eyes. A few words of explanation, a letter of introduction from Churchill, and Charles made me welcome for the season. The unostentatious, thoughtful hospitality of that household is a treasured memory. Charles had just then returned from a trip by dogteam to his Eskimo friends on the Kazan. He had cov-



◀ FLYING OUT OF CHURCHILL on Hudson Bay, the plane deposited the author and his equipment on the ice at the northwest extremity of Nueltin Lake, on the last day of May. Left: plane mechanic Don Gallagher, right: pilot John M. Bourassa

▼ SNOW still lay eaves-high around the cabins of the Schweder brothers—traders, trappers, and travelers extraordinary—with whom the author made his headquarters





▲ SOLITARY CAMP on Josie's Bay. The author passed a delightful week here in July, when the midsummer lull in the caribou migrations permitted him to turn his attention to plants, fishes, and birds



▲ SUMMER REPAIRS: new roof-paper for the Windy River Post, with fresh-cut grass beneath. In a few months, only the tower and the smoke pipe will mark the location of the cabin beneath the snow

ered the 60 miles in some 18 hours, making only three one-hour stops to "boil the kettle."

Several days later the other members of the household returned with another dogteam from the south end of Nueltin Lake. First among them was Fred, a keen Nimrod, trapper, and fisherman, with a quiet smile and a voice so soft as to be little more than audible. Next was his ten-year-old brother Mike, who proved to be probably the best all-round cook of his age in the length and breadth of Keewatin; he performed yeoman service in the kitchen whenever we two were left alone in camp.

The remaining two members were the first Eskimos of my acquaintance—a fifteen-year-old boy, Anoteelik, and his five-year-old sister, whose original name had been shortened to Rita. Their presence on the Windy River was wrapped up in a tale of stark tragedy on the Barrens to the north; it was at the same time eloquent testimony to the great-heartedness of Charles Schweder. The Eskimos are notoriously happy-go-lucky, with little more thought of the morrow than the grasshopper of Aesop's fable. From time immemorial the Padlimiut have depended upon the migratory throngs of Barren Ground caribou (*Rangifer arcticus arcticus*) for their main sustenance. They know from experience that these animals follow a general pattern in their spring and fall migrations; but these move-

ments are so variable that no man may say with any degree of certainty just when or in what numbers the caribou will appear in a given locality. So, in the fall of 1946, the Kazan River band lost their gamble on the coming of the *tooktoo*; all but the merest fraction of the usual thousands passed the upper Kazan to one side. By the next spring eight out of the band of 27 had met a grim end by starvation. All the victims were women and children; the men and even some of the dogs survived. Such is the status of chivalry in this part of Eskimo land.

When Charles reported the situation in March after a 250-mile trip to Reindeer Lake, the government shipped emergency provisions by air as far as Nueltin Lake. From that point Charles hauled them by sleigh to the Kazan. On one of his trips, Anoteelik begged to be taken away. Charles bade him come and take his thin little sister with him. Their own mother had already succumbed. So the children became members of the household on Windy River and flourished thenceforth under Charles's understanding care.

The vast bulk of the local caribou ordinarily abandon the Barren Grounds to winter in the "Land of Little Sticks," stretching away southward to the Churchill and Nelson Rivers. The return movement reaches the north end of Nueltin Lake approximately in early May and continues throughout June.

Thus it was in full swing at the time of my arrival. The lakes and rivers, still icebound, offered no impediment to the progress of the caribou. In fact, the animals utilize these open areas for their resting places, where the wide outlook prevents their ancient enemy, the wolf, from making an unobserved approach. During the plane flight from Churchill we had noted three separate bands on the frozen surface of Seal River, the largest numbering about 40 individuals; then a few others elsewhere, including 20 or so on Windy Bay.

Along the south side of this bay the rugged Windy Hills rise rather abruptly to some 500 feet. But the mile-long South Bay, meeting Windy Bay at right angles, affords a convenient break in the hills; and the adjoining slopes are negotiated readily by the caribou. So here they converge from the neighboring heights, making long, slanting trails through the snow. They pass out of the mouth of South Bay as through a funnel, then follow a regular path across Windy Bay, until they are lost to view among islands or on the limitless Barrens to the northward.

Until the "break-up" occurred in mid-June, bands were seen almost daily following this line of march. The numbers in each might be anywhere from 3 to 75. They traveled in long files and yet not altogether in a single file. For the most part they progressed at a moderate walk-

Besides resorting to the frozen lakes and rivers for their resting periods, the caribou will select some commanding hilltop for the same purpose. About 75 appeared in mid-day on a rocky knoll on the far side of Windy River. While some kept on feeding, many lay down on snowbanks, apparently preferring these to the plentiful patches of bare ground. In the variety of their attitudes on this height, the animals were disposed perhaps more like alpine chamois than like the generally conceived masses of caribou on the low Barrens. What a subject for a John Guille Millais!

When the bay ice began to break up in June, the caribou were forced to pass around the bay and swim across the Windy River. Our camp, a few hundred yards up the river

So the migration continued, in gradually lessening numbers, as summer came with a rush to the Barrens. On July 1, the final band of caribou passed our camp. During the early part of this month the animals keep advancing, till they have practically deserted the southern Barrens. Meanwhile, the does bring forth their fawns on green arctic pastures far up toward the continental limits. Presently the augmented hosts take up their southward march—the mightiest, most imposing phenomenon still to be witnessed among the land mammals of North America.

By the end of July an air of expectancy pervades the camp. "When will the caribou come?" is the thought in every mind. The hunters roam the Barrens or occupy some lookout post on high ground. But July passed, and the first few days of August; and still not a solitary buck appeared on the horizon. It

The normal pattern of fall migration in this area, as explained by Charles and Fred, is somewhat as follows. The caribou generally return from the north about the first of August. Bucks are likely to form the advance elements of the fall migration as well as the rear guard of the spring migration; this suggests that they may not go so far north as the does. The forerunners come in small and very gradually increasing numbers, until presently a big movement, composed of perhaps thousands of individuals, will pass by in three or four days. Oddly enough, there is generally a definite retrograde movement northward into the Barrens sometime in September. Occasionally considerable numbers may remain there during the winter. In most years, however, the final passage into the timbered country may occur in November, and perhaps the largest herds of the year will then be seen.

Even by mid-August only a few caribou had appeared. On the 20th, however, Fred reported about 300 of the animals moving in our direction across the Barrens north of

IN CARIBOU LAND



◀ THE STRANGELY-ASSORTED "FAMILY" at Windy River: the zoologist with a dip net, Rita with a rag doll, Fred with a Winchester, Mike with a game bag, and Anoteelik with a caribou spear

▼ RITA looks on while Fred and the zoologist prepare a caribou skin. Old hides nailed to the logs of the earth-banked cabin help keep out the winter cold

Windy Bay. On the same afternoon I enjoyed a glorious spectacle from "Pile o' Rocks," a lookout point northwest of camp. Only a couple of miles to the south the imposing Windy Hills shut off the view, but in other directions my gaze swept over the unending Barrens for distances of 10 to 25 miles before other hills rose to mark the horizon. Two rivers, two sizable lakes, and tundra ponds almost without number were visible in this expanse of some 400 square miles. Off to the eastward, beyond Little River, several groups of caribou, numbering from 3 to 20 or 25 individuals, were feeding quietly. Their fresh dark autumn coats showed up much more conspicuously than had the cream-buff of their winter coats in June.

Presently the scene became livelier, as the largest band, composed of does and fawns as well as lordly bucks with enormous antlers and white manes, started to romp across the Barrens. The mosquitoes and black flies, which harry the animals throughout the summer, may have gathered in hordes beyond the limit of quiet endurance. Or one or the other of the two kinds of parasitic flies that bring year-long misery to the caribou may have been on the rampage. The larvae of one burrow beneath the skin of the victim's back and become the disgusting warbles that are found in numbers up to a couple of hundred on a single animal. The other fly deposits its eggs in the nostrils, and the resulting lar-



vae infest the animal's throat. Both parasites scourge their victims from one summer to the next. The caribou instinctively fear the adult flies; they may endeavor to fend them off by an extraordinarily vigorous shaking of their sides and head, or they may simply stampede in the vain hope of outdistancing their tormentors. Thus the sight of rapidly trotting caribou becomes a familiar one, until September frosts put an end to the winged pests.

As the eye swept farther over that silent, lonely land, still other caribou were disclosed singly or in groups scattered here and there over a couple of square miles. There was no strong herding instinct as they grazed at will. Even when on the march, they straggled along, some as much as 10 to 20 yards apart. After a couple of hours, the movement reached a lull; the lowering sun and

the cooling atmosphere, with a lessening number of black flies, indicated that it was time to turn back to camp. Never before had I so fully realized my dream of watching these wonderful creatures in the wild freedom of their arctic home.

The far-roaming caribou put their mark on the land to a greater extent than any other North American mammals of the present day. The hoofs of generation after generation have beaten trails and kept them open, till there is a network perhaps millions of miles in total extent over the whole Barren Grounds and the adjacent timbered country. They are especially in evidence on the long gravelly ridges in the Barrens. It is vastly exhilarating to a naturalist to direct his own course along these ancient, well-marked paths.

On the afternoon of August 24, Fred came into the cabin and an-



nounced "a bunch o' deer" (as caribou are called in the North) moving along a ridge on the east. With movie camera and tripod in hand, and keeping under cover of the small spruces that grow in the low ground between the ridges, I came up with several bucks as they emerged into a small open bog. A few moments later a lone, inquisitive, one-horned doe appeared in another part of the bog and began to come closer. While engrossed with this animal, I caught a movement out of the corner of my eye, and there the bog was full of caribou! They had evidently come up behind me and now stood only about 50 yards away. I was absolutely in the open, with not a vestige of cover between me and the 75 to 100 caribou. This herd was composed very largely, if not wholly, of bucks. Quite unconscious of their own power, they could have, if so minded, utterly demolished me under their hoofs in a few seconds' time. It was an extraordinarily gratifying experience to have arrived at such intimate terms with these magnificent, peaceable denizens of the Barren Grounds.

After a spell of rain that halted camera operations, I returned to the

same bog and presently filmed a band of 17 caribou as they ambled unconcernedly along the edge of a tundra pond, without even looking in my direction. Then the largest herd of my whole season's experience, numbering perhaps 150, passed along a ridge on the opposite side of the bog. A heavily maned patriarch brought up the rear of that superb throng. Like various other individuals observed from time to time, he seemed to be limping slightly, perhaps from old wounds. The natives make a practice of seeking out the older bucks, not at all for the glory of their antlers but simply for the extra-thick fat stored beneath their hides.

August 25 was a gala day on Little River. My first station was on a rather open slope, among clumps of dwarf birch, with a clear view of the crossing place at the rapid. A temperature in the 40's, with a brisk northwest breeze, suppressed the black flies. While waiting for the caribou to come into sight across the river, I could drink my fill of the rolling, drumlin-like, rock-studded Barrens, with little thickets of dwarf birch struggling up the slopes and copses of small spruce and tamarack scattered along their bases. On the

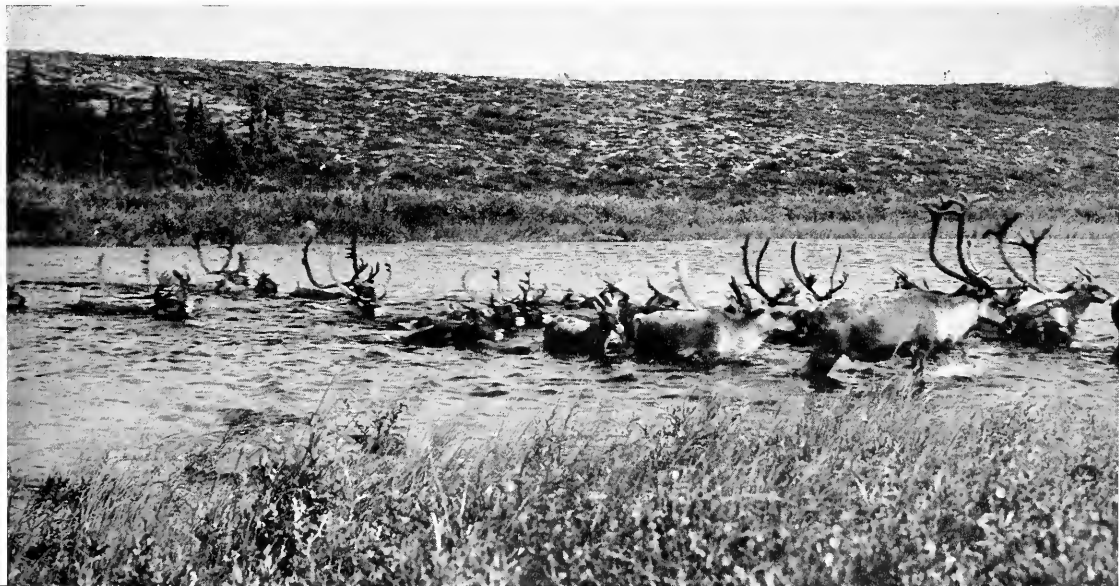
near side of the river was a fringing strip of willows, up to ten feet high, through which the caribou had made numerous trails.

The animals came along at intervals from the eastward, in bands up to 75 strong. The big movement was definitely under way. A small number might make the crossing in one or two files, but one of the larger bands might spread out widely. The towering antlers of an occasional patriarch nearly doubled his stature. In buck and doe alike, marked asymmetry in the main beams of the antlers was common. Some of the does were one-horned, and some altogether hornless. Although summer was nearly over, many of the does still retained a large part of their previous winter's coat. Here at the rapid the adults walked across on the rocky bottom, but the fawns were obliged to swim in the deeper parts.

The larger the band, the less heedful the animals were of possible danger. It was evidently a case of each individual depending for its safety on the sheer numbers about it. How different, on the other hand, was the attitude of a single doe, accompanied by her fawn. In approaching the river, she would look

▼ A BAND composed chiefly of big bucks, crossing Little River. When seen head-on, their white-ringed snouts

give a comical touch to these majestic creatures. The antlers will not lose their velvet until mid-September



long and carefully, both upstream and down, for any possible lurking foe. Instinct bade her take these precautions in behalf of her heedless offspring. The fawn was obviously entrusting everything to its circum-spect dam; its only concern was not to be left behind. But the manner in which her scrutiny passed right over the motionless human figure in plain view on the opposite bank might have been tragic indeed under ordinary circumstances. It was perhaps the difficulty of keeping close to the does at the river passages that led the fawns at such places to give frequent voice to their curious, explosive grunt—a raucous *gucuf* or *gorr*. Perhaps it is equivalent to calling, “Where are you, mammy?” or “Don’t leave me behind!”

As the caribou emerge from the river after swimming across, they shake the water off their coats in a cloud of spray. They may begin as soon as their bellies are clear of the shoal water, and they may repeat the process a couple of times as they climb up the adjoining ridge. The action is much like that of a dog under similar circumstances. The shaking includes not only the body but the head, ears, and tail.

Each day’s vigil on Little River brought delightful experiences. August 26 was marked by mist squalls and a maximum temperature of only 45°, and there was a slight slackening in the caribou pageant. But on this and the following days I continued to enjoy unusual opportunities for studying the animals at close quarters. Especially when the afternoon sun shone on the glistening autumn coats of the bucks, does, and fawns was the broadside array superb. They would pause now and then to watch me crank up the camera and only occasionally moved off hurriedly. Then a band of them might climb the steep ridge behind me and halt in picturesque outline against the sky to look at the strange figure below them. At one time, three or four mighty bucks were grouped at the water’s edge in a pose fit for a Landseer’s brush. Such scenes represented life on the Barren Grounds in one of its most en-

chanting aspects. In this caribou Elysium I felt that the field experiences of a lifetime had soared to an undreamed-of climax.

From in front the swimming animals present a curious appearance. There is a whitish ring around the end of a dark snout, strongly suggesting the white lips of a black-faced comedian. On land, the whitish patches just above the hoofs, resembling spats, give a dainty touch to the trotting caribou. In the water, they are so buoyant that the entire line of their backs, including the tail, projects above the surface. The tail points straight into the air, except that the very tip droops backward a bit. The heavy antlers of the bucks force their heads a little lower, so that the under side of the jaws just touches the surface, whereas the does keep their whole heads out.

Every caribou has a curious gland in each hind foot, opening in the cleft between the hoofs and supplying an oily secretion to the hairs adjacent. Apparently one of its functions is to anoint the soft, growing tips of the antlers while they are in the velvet stage. A strange habit of leaping into the air when starting off in sudden and perhaps panicky flight has been connected with this gland by A. Radclyffe Dugmore. He concluded that these frightened leaps expelled the fluid from the foot glands and that it served as a warning signal, for every caribou arriving at such a spot, even hours afterwards, would start violently and run off with every indication of fear.

While watching the animals on the Barrens, and especially at the river crossings, I had exceptional opportunities to glean information on their feeding habits. During the warmer months they showed a distinct preference for fresh green foliage and herbage. Apparently it is mostly in winter, when these things are no longer to be had, that they turn to their traditionally staple food, the so-called reindeer “moss.” Charles said that he had seen them digging through four feet of snow in winter to reach the reindeer moss beneath. This is actually not a moss but a lichen—or rather several species of lichens of the genus *Cladonia*.

*donia*. These grow everywhere over the Barrens and far down into the wooded country where the animals range in winter. They are creamy or pale grayish in color, with a slight greenish cast. In their intricate branching shapes they are distinctly appealing to the eye; especially a certain species (*C. alpestris*) that grows in the form of numerous little coalescing domes.

In summer, when the sedges and grasses shoot up in the bogs, the caribou may be seen grazing there. Among the deciduous shrubs, they are distinctly fond of the leaves of dwarf birch, and they likewise nip off the terminal twigs, which they share with the ptarmigan and the Arctic hares. They browse contentedly in the willow thickets bordering the rivers, and they also partake of alder. In August and September, when mushrooms of various shapes, sizes, and colors enliven the Barrens, the caribou feed upon them to such an extent that the Eskimos give these plants a name signifying “caribou food.”

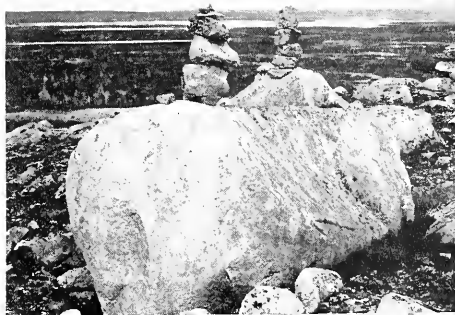
It was interesting to notice that when a band of half a dozen lay down in the open to rest and presumably to chew the cud, each of them faced *down wind*. In this position their eyes would inform them of any enemy coming from that direction, while their noses would serve for the opposite.

Among all the caribou killed locally, only a small proportion of the hides are prepared for domestic use, and practically none reach the fur market. The children of the camp generally take over the task of drying them. With head and legs cut off, most of the hides are stretched taut and pegged out on the ground, fur side down; a few are nailed to the outer wall of a log storehouse. Eventually they are used for winter clothing, blankets, sleeping bags, upholstery, and tent material. Those with the fresh, short pelage of early autumn, before the long winter hair has reached its full growth, are the ones in demand.

Aside from primitive man, the only other considerable predatory foe confronting the Barren Ground caribou in ages past was the wolf.



▲ THREE HARDY CHIPEWYAN INDIANS come from the south end of Nueltin Lake for trading in late October. They had prepared themselves for the freeze-up by bringing a toboggan and several sled dogs



▲ "STONE MEN" are set up along the ridges by Eskimo and Indian hunters to turn the migrating animals toward a strategic location. A single pile may also be put up to guide a hunter back to his kill

▼ FRED, just in from the Barrens with a load of caribou meat: a typical November scene at remote Windy River Post, where the Schweder brothers have fashioned an unusual but happy existence in the wilderness



▲ ZERO WEATHER on the last day of November, a rocky ridge in the Windy Hills, where white spruce sentinels withstand the blasts of the arctic winter



Neither of these had any serious effect on the size or condition of the herds. In fact, the wolf, by eliminating the weaklings, the sickly, and the less alert individuals, may be safely considered a benefactor of the species as a whole—a regulator and preserver of its vitality. Up to a century or two ago, when the baneful effect of civilized man began to be felt, the caribou thrived and multiplied to a point where they probably strained the grazing capacity

of the Barren Grounds. They were numbered by millions and doubtless owed their vigor and their success as a species in no small measure to their friendly enemy, the wolf. By way of testimony on this point, we may cite the only two regions of the world where caribou do not share their territory with the wolf—Spitsbergen and the Queen Charlotte Islands. Instead of thriving in the absence of such a natural predator, the animals of both regions are

the runts of the whole caribou tribe, and those of the Queen Charlottes are perilously close to extinction. The lesson is obvious: it is folly for man to imagine that he can benefit the caribou by eliminating the wolf.

It is virtually axiomatic that no predatory species (other than man) exterminates its own food supply. Long ago nature must have established a fairly definite ratio between the populations of the wolf and the caribou. Although a certain fluctua-

*Continued on page 239*



◀ A CHICK'S-EYE VIEW of a bird you may pass unnoticed on the beach because of its effective natural camouflage

▼ A YOUNG SNOWY PLOVER, which could not wander far without evoking serious anxiety in its parents

## Beachcombers

The snowy plover is a distinguished camouflage artist and a born master of diversion strategy

By LEWIS WAYNE WALKER

*Photographs by the author*

THE snowy plover, most beguiling bird to be found on a Southern California beach, has been called a variety of names, but none of them are derogatory, because the adjective "cute" is used as a prefix for all. Offhand, I feel that the snowy is the only beach bird that really fits this overworked word.

Every mannerism, whether executed when there is need to lead an enemy from the nesting area or performed while procuring food under the lip of a crashing breaker, has a certain something that seems to separate these birds from ordinary shore-line feeders. Perhaps it is their two-tone finish—immaculate breast and sand-colored back—that magnetically draws the interest of folk who normally show no interest in birds. Perhaps it is their absurdly round, egglike shape and seemingly inadequate legs. It could be their precision of movement, for motion alone makes the bird visible, while rigidity creates a

perfect blend into sandy surroundings. To many sun-tan addicts these "now-you-see-it, now-you-don't" maneuvers are startling examples of protective coloration. The bird unconsciously utilizes plumage in a successful struggle for survival on exposed terrain where there are no hiding places.

Their choice of nesting sites is clear proof that the snowy plovers depend upon deception, and their abundance on beaches crowded with week-end swimmers shows that their deception has been successful. Their eggs, three in number, are placed in a slight depression on the dry sand above the high-tide mark. Sometimes bits of shell, dried seaweed, or other debris are pulled in to form a rim, but such ornamentation is not a "must" in snowy housebuilding. Tracerics of black are scrawled over the gray-toned eggs, and if the nest is unmarked, they blend into the sand to the point of invisibility.

For this reason, very few nests



are found by accident. Instead, you will locate them after a long wait for the adult to disclose them. However, this wait is far from tedious, because both parents will combine talents that may well entice the watcher away from the area. They employ various ruses, depending on the nearness of the human observer and the imminence of nest discovery. If the birds are only mildly disturbed, their behavior will give the impression that every footprint in the sand is the nesting site, and their solicitation for these empty holes carries real conviction. On numerous occasions, I have been fooled into supposing that a nest had been found when one of the pair stealthily sneaked away from its mate, who was fondling

imaginary eggs beneath its feathers.

If the watcher chooses a vantage point close to the real nest, the pantomime of the broken wing will usually be enacted. However, snowy plovers seem a little more consistent than some of the other birds that resort to this act. Killdeer and nighthawks often alternate injuries from side to side and thus spoil the illusion. But the snowys usually "stick to their story" by dragging only one injured member as long as there is a chance that the trick will work.

Several seasons ago, near the Mexican village of Ensenada, I located three young plovers that had just come out of their shells. Each of these tiny young could sit on a nickel without overlapping the edges. They seemed to forget their parents' command to "freeze" as I lifted them off the ground, for when replaced on the sand, they scattered at divergent angles. Near by there was a rusted one-pound coffee can, which I buried in the sand as a corral to keep the young together. Then from a distance I awaited developments.

The broken-wing act ceased as soon as I left the vicinity, and the adults flew off down the beach. Five minutes later, however, they stealthily returned in a series of fast runs and dead stops and peered into the buried can. Then, seemingly unperturbed, they walked a score of feet away and started to catch kelp flies and other insects



▲ "SANDY" lying low amid his sandy background

that live on rotting seaweed. Occasionally I could see the head of a young one almost reach the rim of the can in a vain attempt to join its foraging parents.

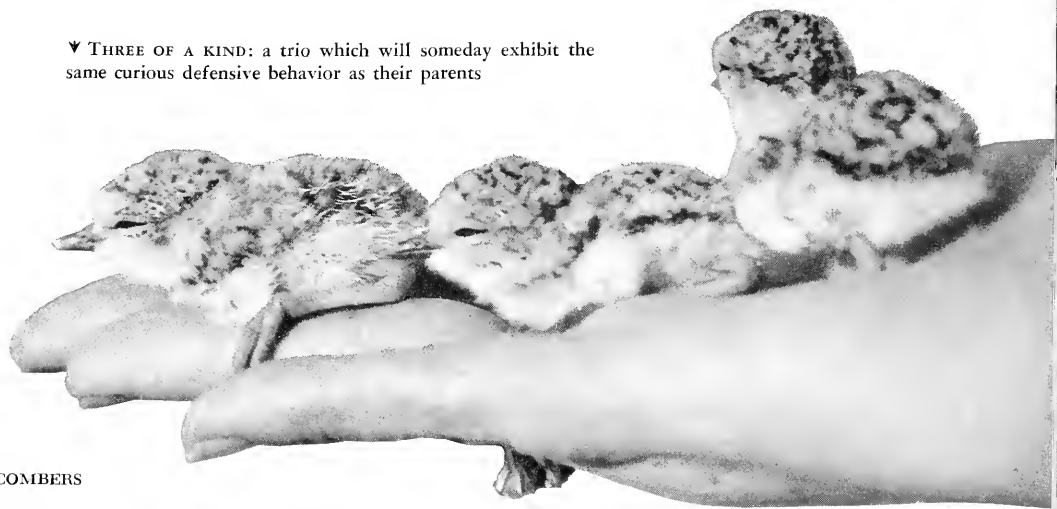
Many more minutes passed before the adults showed by their actions that all did not suit them. Their feeding gradually worked toward their imprisoned chicks, and they made several nonstop runs past the can to look inside. Although I was far out of hearing, I imagine that these trips were made to urge the chicks to greater effort, for each time a parent approached, the young would scramble about in a wild endeavor to reach the sand above. Finally, in the belief that the baffled adults had met a situation with which they could not cope, I thought of freeing the young. And then it happened!

Many will say that what I am about to describe was accidental.

The specialist in animal behavior, who usually knows what he is talking about, will argue that controlled experiments do not show that birds are intelligent enough to have been "using their heads." However, no one can object to my recounting what I observed; and I, for one, cannot blame it on instinct or accident.

The adults circled the rim of the can and paused for the first time, on the edge. Presently both started to kick the loose sand at the chicks below. Within several minutes the efficacy of this maneuver became apparent, for the heads of the jumping chicks now came above the tin, and sometimes they almost chinned themselves to the surface. A few more kicks by the adults raised the floor level to a height necessary for freedom, and then the reunited family scurried down the beach.

▼ THREE OF A KIND: a trio which will someday exhibit the same curious defensive behavior as their parents





National Park Service photo

# City of the Crooked Water

Like an oasis in a region of famine, the ancient settlement called Tuzigoot flourished, but its fertility seems also to have spelled its doom

By NELL MURBARGER

ARIZONA'S splendid cliff dwellings and pueblo ruins have for two generations been among the state's leading tourist attractions. Some of them—such as Montezuma's Castle and Casa Grande—have become virtually as famous as the Colosseum of Rome, and every season new hordes trail through them and exclaim over them in half-a-hundred languages.

But not all of Arizona's ruins are so renowned. For example, there is Tuzigoot — City of the Crooked Water. While it is one of the state's most readily accessible pueblos and is considered large and of exceptional interest, even by southwestern standards, this is a place all too seldom visited by the casual traveler. Situated in the fertile Verde Valley of north-central Arizona, between Flagstaff and Prescott, Tuzigoot is reached via paved U.S. 89-A to Clarkdale, where a winding, graded road leads across the Verde River to the ruin, only a mile and a half distant.

This is scenic country. To one

side rises the huge bulk of Mingus Mountain, with a necklace of copper mines around its throat and at its feet the milling town of Clarkdale. Beyond the town lies a flat, green valley with pocket-sized fields of alfalfa and velvety meadows where fat, red cows and sleepy burros graze and, now and then, a little flock of sheep or goats. Through this pleasant pastoral scene winds the Verde, clear and sparkling, with age-old cottonwoods and willows overhanging its banks.

It is this river that gives the old ruin its name. What the pueblo may have been called by the ancient ones who built and occupied it is something no man knows, but its present name of Tuzigoot—City of the Crooked Water—was given it long decades ago by the Tonto Apaches.

A short distance beyond the river a short, steep rise brings the visitor to the pueblo-style administration buildings. Since the fascinating hilltop ruins are partially visible

from the parking area, the natural impulse is to begin exploration at once. Much better understanding and appreciation of the whole may be had, however, by first touring the splendid museum maintained here by the National Park Service—one of the largest and most complete exhibits to be found in any of our Southwest National Monuments. Here it is possible to learn virtually everything man knows of the story of Tuzigoot.

It is a strange story, one that had its opening about ten centuries ago—possibly a couple of hundred years before the Crusades. Great as this time lapse has been, the green valley surrounding Tuzigoot probably appears little different today from the way it did centuries ago when Tuzigoot was young. Then, of course, there were in the fields neither cattle nor horses, since these animals were unknown in Arizona before the arrival of the Spanish explorers, nearly six centuries after this story opens. Otherwise the scene was about the same. Even



r about six and one-half cen-  
ago, Tuzigoot was a village-  
strategically situated for defense  
rtile haven from drought

► THE APEX of the Tuzigoot ruin,  
showing the doorless rooms which  
had to be entered by pole ladders  
through small holes in the ceiling

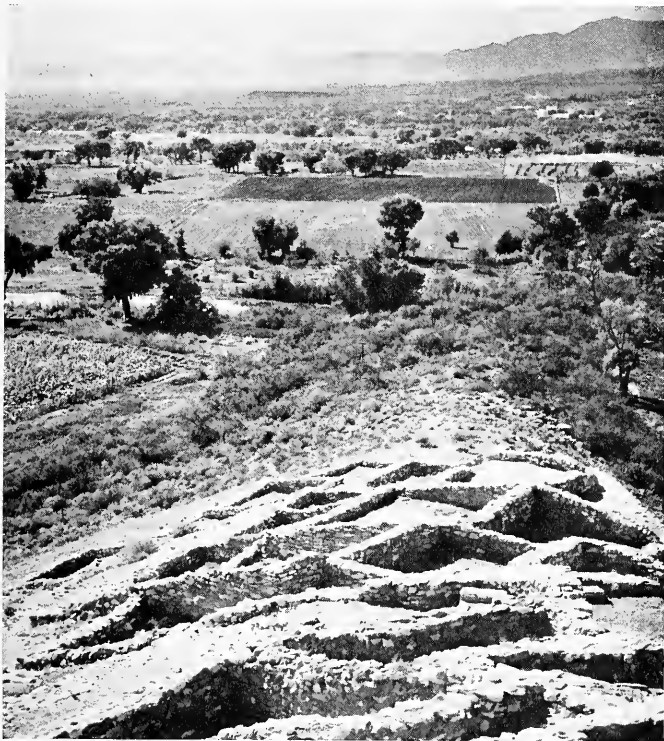
then the valley was checkerboarded  
with productive fields, for these In-  
dians were peaceful, thrifty farm-  
ers who cultivated corn and beans,  
pumpkins and cotton. From the  
fruits of their labor they filled their  
tables and granaries and wove cloth  
to cover their bodies. To supple-  
ment the natural rainfall, they ir-  
rigated the fields by means of in-  
geniously engineered canals and  
laterals, which carried an assured  
volume of water from the full-  
flowing Verde.

For shelter, these First People  
lived in wattlework huts. They  
were a framework of closely set  
poles plastered over with mud, and  
because they were partially sunken  
in the ground archaeologists have

called them pit houses. The floors  
were of hard-packed earth. There  
were no windows, and the whole  
dwelling was strictly utilitarian,  
but it sufficed to shed the rain and  
to turn the not-too-chilly wind. For  
implements these people worked  
stone into a variety of forms, and  
for cooking and storage purposes  
they made buff-colored pottery ves-  
sels. On the whole, life in the City  
of the Crooked Water was relatively  
complete without being complex.

But word of a good thing always  
gets around, and about the year  
A.D. 1000 these simple farmers be-  
gan having callers from the north.  
Like the Man-Who-Came-to-Din-  
ner, these casual visitors remained  
as permanent settlers. They were

Nell Murbarger photo



▲ EVEN BEFORE THE STONE VILLAGE was built, Indians living in wattlework  
huts tilled the valley with the help of irrigation, and it probably looked  
much as it does today

CITY OF THE CROOKED WATER



Nell Murbarger photo

Pueblo Indians, and they brought  
to the Crooked Water a lot of fancy  
new ideas.

In the first place, they disap-  
proved of living in valleys. Unlike  
the Children of the Verde, they  
had had experience with wars and  
raiders, and they wanted to be lo-  
cated on the heights, where they  
might watch for possible enemies.  
Further, they had progressed archi-  
tecturally far beyond the primitive  
wattle huts.

While the hut-dwellers looked  
on, doubtless in amazement and  
possibly in derision, these advanced  
newcomers began the systematic  
erection of compact stone-masonry  
houses. They built them on a near-  
by hilltop, commanding a view for  
many miles on every side. Tuzi-  
goot's first stone pueblo contained  
only 15 or 20 rooms, and it prob-  
ably housed no more than 50 or 75  
persons.

Strangely, the pueblo showed  
little growth during the next 200  
years. Apparently things went along  
smoothly and peaceably enough,  
but there seems to have been no  
land rush. Had climatic conditions  
continued to be normal, it is im-  
possible to say how long this static  
phase might have prevailed; but  
farther north in Arizona and south-  
western Colorado, a blight had  
fallen upon the earth.

The year 1276 ushered in a great  
drought cycle, which continued un-  
abated for 23 years. During that  
period, practically no moisture fell.

# Natural History CRYPTOMAZE

MINERALS, By EDWARD DEMBITZ

In this puzzle you are given a set of definitions, each with a set of blank spaces (Part I), and a diagram to be filled in (Part II).

**PART I.** Each definition is a clue to a word whose letters you are to insert in the blank spaces preceding the definition. These words appear in recent issues of NATURAL HISTORY Magazine.

- 2 18 6 29 He explored Alaska and left his name on a sheep, river, mountain, and porpoise
- 11 35 37 31 16 42 A priestess at Delphi who prophesied under the influence of Datura seeds
- 12 7 3 15 41 One member of this feathered family covers its nest in case of danger or absence
- 39 13 21 20 27 5 A basis of fruit jellies and a major component of ramie gums
- 34 22 16 4 10 Glacier-built earth forming much of Corn Belt, once thought brought by bergs
- 36 42 26 30 41 22 He well deserved his name after he led the party that discovered Yosemite
- 9 38 24 11 31 In mythology, a beautiful maiden; in entomology, an immature form
- 30 3 17 24 23 40 Mediterranean insects that were the source of one of the oldest dyestuffs (red)
- 33 32 26 40 32 A tree and wood used for rafts by ancient and modern Peruvians
- 4 1 18 28 30 6 27 5 One flew a famous kite; one searched for a famous passage
- 37 18 39 16 19 25 18 A pudding ingredient familiar to all, made from the poisonous cassava plant
- 42 28 25 31 19 14 35 Hors d'oeuvre for the gourmet, pièce de résistance for the guany
- 36 32 1 34 "King of the Museum Builders," who taught techniques to many young scientists
- 10 8 24 15 29 23 33 8 12 A beetle, named for its habit of rolling balls of dung
- 36 41 18 14 23 7 A finchlike bird which, working communally, builds world's largest nests
- 32 9 20 17 38 21 27 2 13 A new drug, claimed to cure livestock disease transmitted by tsetse flies

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The contest is open to everyone except employees of the American Museum and of John Wiley and Sons, and their families.

**PART II.** When you have filled in all the letters in Part I, transfer them to the proper numbers in the boxes in the diagram below.

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35
36	37	38	39	40	41	42

When the diagram is completed, the unshaded spaces will form a word maze containing at least 25 names of MINERALS. To find one of these minerals, begin with a letter and move from space to adjoining space in any direction, including diagonally, until the name is spelled out. Do not pass through or use letters in shaded spaces while forming names. But it is permissible to pass diagonally between two, as from 17 to 11. Do not form double letters by jumping up and down on the same square. Do not skip squares in the middle of a two-word name.

**THREE PRIZES.** The three contestants submitting the largest number of names of minerals fitting this puzzle will each receive a copy of the MANUAL OF MINERALOGY by Dana and Hurlbut, an outstanding book published by John Wiley and Sons, Inc.

Names of minerals must appear in bold-faced type in the main A-Z section of Webster's New International Dictionary—1948 (unabridged) in order to be eligible. Names in bold-faced type below the line at the bottom of the page are allowable. Different names for the same mineral will be accepted. So will variants, alternative spellings, and scientific or technical names, providing they appear in bold-faced type.

Flagrant disregard of the rules will disqualify a contestant.

In case of ties, duplicate prizes will be awarded.

Entries must be postmarked on or before June 1 and be received by June 6, 1949. You need send only your list of minerals, not the "checkerboard."

Winners and their scores will be published in NATURAL HISTORY for September, 1949.

Seeds failed to sprout in the parched fields; or, having sprouted, the starved plants withered and turned brown. Long before harvesting, their burned leaves were rattling crisply in the hot wind. Conditions at last reached the point where entire villages were facing death by starvation.

Perhaps some of these harried

people had heard rumors of a remarkable Shangri-La a few days' journey southward—a green and luxuriant valley through which flowed a crooked blue river, where the Rain Gods still sent their life-giving bounty to bless the earth. Or perhaps they had not heard of it. Perhaps they simply started forth desperately and blindly, seeking

any port in the storm. In either case, starving refugees from the drought-stricken lands to the north were soon pouring into the Verde.

During that 23-year drought, the population of Tuzigoot doubled and redoubled. And 100 years later, the original hill was all but hidden by buildings, and the influx had spread to surrounding hills, where

more than 20 new pueblos had been built.

And then something happened. No one knows exactly what. Possibly enemy invaders succeeded in storming the hilltop villages, although excavation has revealed no evidence of widespread carnage or battle devastation. More likely the tremendous increase in population, with resultant overcrowding and lack of adequate sanitation, eventually resulted in contaminated water with ultimate epidemics and death. Whatever the determining factor may have been, by 1400 or very soon afterward Tuzigoot's great stone pueblo had been abandoned to the winds and to its dead.

Nearly five centuries were to pass before students of archaeology began delving into those ruins, by then all but hidden beneath the accumulated debris of the years. With federal assistance and cooperation of the Phelps-Dodge Corporation (owner of vast copper interests in the vicinity), the pueblo of Tuzigoot was completely excavated in 1934-35. Later, the ruin's 42-acre site, as well as the museum and its superb collection, was donated to Uncle Sam through the interest of local public-spirited citizens, and in 1939 Tuzigoot National Monument was created by presidential proclamation. Since that time, the place has been administered by the National Park Service, with a resident custodian in charge.

That, in brief, is the story of Tuzigoot.

Leaving the museum, a rock-bordered path winds up the hill to the masonry pueblo. It remains largely as it was excavated, only a few rooms having been restored to illustrate the probable manner

in which they were finished and equipped.

As southwestern pueblos go, these rooms are singularly large. Several of them are as much as fifteen by twenty feet square, and the average is around twelve by eighteen feet. Compared to Montezuma's Castle, where some of the rooms are but five or six feet square, these must have seemed little short of palatial. Each room, it is believed, was occupied by a single family.

There were no doors in the outer walls. For the sake of safety, entry was gained only by pole ladders extending downward through small apertures in each ceiling. The pueblo was limited mainly to a single story, although eighteen or twenty rooms were originally built with a second story.

On the west slope of the hill is situated a group of rooms that evidently had fallen into disuse while the remainder of the pueblo was still actively occupied. Now, this City of the Crooked Water was not modern either in design or in plumbing. Sewage and trash were simply heaved out through the "front door."

As refuse and debris were cast out by occupants of overlooking apartments, it cascaded down the slope into these abandoned quarters below. In the course of time this residue accumulated to a depth of nearly a dozen feet—four feet above the topmost walls of the old rooms!

Unappetizing as this method of trash-disposal must seem, contemplation of the practice becomes even more abhorrent with the knowledge that this and other refuse piles on the hillside saw

double duty as cemeteries. It was the common custom of these people to consign their adult dead to one of the several city dumps. Infant burials were more commonly made within the pueblo itself. Excavations to date have disclosed 170 such interments. Some infants were buried in wall niches, a custom that seems to be peculiar to Tuzigoot.

On the east slope, after refuse had accumulated to a depth of four feet and many burials had been made there, additional rooms were built on top, the already interred corpses being left to rest in peace beneath the floors of the new living rooms.

That this procedure did not denote callousness or indifference toward death is indicated, archaeologists testify, by the splendid burial offerings found with Tuzigoot's dead. Of more than 400 burials excavated here, nearly one-third contained pottery offerings. Many of these pieces were truly magnificent specimens, apparently traded from the north. Jewelry, also, was a common offering to the dead. Some of the finer pieces found here include rare turquoise mosaic, in which the frog motif is of frequent occurrence. One ensemble of turquoise necklace and bangles is said to be the finest of its type ever taken from an American excavation. Other beads and bracelets are of seashell traded from the Pacific Coast and the Gulf of California.

Although these people were wonder-workers in stone, having progressed farther in that art than in any other handicraft, stone weapons and other implements of like nature were not buried with the dead at Tuzigoot, as in the pueblos to the northeast.

The masonry of the city cannot be said to be of a high type if one uses such criteria as the pre-shaping of stone, coursing, and the amount of adobe mortar. However, the stones were selected with care and laid in such manner as to provide a relatively smooth surface, both on the outside and within. Almost without exception the old walls still

**Winners of the Seed Plant Cryptomaze** in the March issue of **NATURAL HISTORY**: The three contestants submitting the highest number of seed plants listed in the main section (A-Z) of *Webster's New International Dictionary—1948* (unabridged), in accordance with the rules of the contest, are: **HAROLD EATON**, Jackson Heights, N. Y.—189 seed plants; **DR. HENRY S. RICH**, Bronx, N. Y.—178 seed plants; **CATHERINE VAN AKEN**, New Haven, Conn.—162 seed plants. Each of these winners has received a copy of *The Wild Flower Guide*, by Edgar T. Wherry, published by Doubleday and Company.

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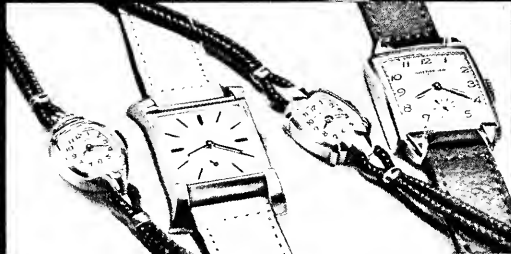


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stand, as true and four-square as though laid with a plumb line.

Scattered along the pathway that leads through the ruins and trodden into the dust underfoot lie countless bits of broken pottery. Their fragmentary designs are still as distinctly clear as when first painted upon the clay, possibly six or eight centuries ago. In many of the rooms are corn-grinding stones, lying just as they were excavated, as well as the smoke-blackened

fireplace  
vanish  
meals

From the pueblo eyes travel over the honeycomb of terraced stone walls to the fertile Verde Valley below and on to the coppery desert hills and purple mountains.

Even as ten centuries ago, there still winds through the valley a placid river, smothered in cotton-

woods. Spreading away on either side are fruitful fields of corn, beans, and pumpkins. Irrigation canals flow deep and unfailing, watering fields in the valley just as did the ancient canals in the days before William of Normandy set out on his conquest of England.

That Time and the World move on is axiomatic. But here, in Arizona's City of the Crooked Water, the movement has been neither very fast nor very far.

## IN CARIBOU LAND

tion of that ratio could be expected from time to time, each fluctuation would be followed by a return to more or less normal conditions. The trend of evolution has doubtless been toward perfecting the wolf in its ability to capture the caribou, and at the same time toward perfecting the caribou in its ability to escape the wolf. Unequal progress of this sort on the part of the two species would presumably have been rather disastrous to one or the other. But it is nature's way to have preserved a proper balance between the abilities of the two species, and thus between their populations. This balance (a rather delicate one) has obviously been upset to some extent by the advent of civilized man to the Barren Grounds.

Everyone is agreed that the numbers of the Barren Ground caribou have declined very seriously during the past half century. Herds of a hundred thousand to several millions, such as were reported in the 1890's, are not in the least likely to be seen again. The primitive human races inhabiting the caribou territory are themselves dwindling; neither they nor any natural enemies can be charged with primary responsibility for the deteriorating status of the caribou. For thousands of years Eskimo, Indian, and wolf worked their will on these animals, and they still flourished amazingly. It is civilized man, with his destructive inventions and his inordinate demands upon wildlife, who must shoulder the major burden of responsibility. As a somewhat minor example, the prospectors who have

*Continued from page 231*

destroyed the food supply of the caribou by burning off large areas in their winter range, merely to facilitate a search for ore-bearing rocks, have been grossly indifferent to the general welfare of both men and animals.

Perhaps the worst threat of all to the caribou has been the introduction of reindeer culture along the arctic coast. This has resulted in interbreeding between the wild caribou and their inferior domesticated relatives. When and if this mixture extends to all the herds of the Barren Grounds, the caribou may be written off the record as a pure species; the animal will have become extinct through dilution, as the biologists express it.

The big movement of August 24 to 28 had represented the peak of the fall migration. For a couple of more days, however, the caribou continued to pass in moderate numbers. On the 30th I returned for another session at Little River and was amply rewarded with camera subjects and notebook material. It was a wonderfully pleasant, balmy day on the Barrens, with a temperature rising close to 70° and bringing out a few black flies and even mosquitoes. There was just a zephyrous breeze, instead of the rude, discomfiting half-gales so prevalent in this well-named area—Windy Lake,

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Windy River, Windy Bay, and Windy Hills! There was a light blue sky, with a few wisps of clouds drifting lazily along, also a light haze around the horizon, such as I seemed to recollect from faraway boyhood days in New England when the chestnut burs were opening in October. Just before and after the fly season, at the beginning and the end of summer, the Barren Grounds are verily in their finest moods.

September and October came and went, with caribou still about in fair numbers. After the final freeze-up

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on November 1, they were less frequent in the vicinity of camp; but during the second week of the month, Charles found thousands moving southward from the Kazan River area, in herds up to 300 strong. That probably represented their final withdrawal from the Barrens to pass the remainder of the winter in the timbered country south of us.

On December 4, a Norseman aircraft, which had left me pleasantly marooned for nearly three months beyond the appointed time of departure, floated down onto the ice of Windy Bay. Two hours later I was off for Churchill. The Barrens and their caribou were behind me, but their memory will linger on—delightful, indelible, and yet well-nigh unbelievable—to the end of my days.

STINGUISHE

## "Wonder House,"

### a Film Portraying the American Museum

The attention of readers is called to a new motion picture entitled "Wonder House," which tells the story of the American Museum of Natural History. It is one of the *This Is America* Series, produced by RKO-Pathé News. Persons interested in seeing this unusual picture should ask the manager of their local theater when it will be shown.

#### "TREETOPS" *Continued from page 215*

he returned to his splashing and gruntings, either unconscious of us or unwilling to be bothered.

Throughout the night the pool alternated between utter silence and the visits of animals. Unfortunately, a fog came up and partially

obscured our view. Often we heard sounds we could not interpret—more splashing, more grunts, and movements in the bush. Sometimes we only knew that heavy bodies were moving in the shadows. The mother rhino and her baby reappeared from time to time, circling down to the water and back through the bush on a regular tour; but as dawn approached, the forest fell still. Then the fog began to lift, and as it thinned we saw the cinnamon-colored bushbuck in the early morning light; and the waterbuck also returned.

We were sleepy at breakfast, for we had been awake all night, but we had enjoyed every moment of the experience and were reluctant to leave for Nyeri when, about ten o'clock, the white hunter and his boys reappeared on the forest trail.

The ladder was lowered, and we made our way to the ground. We examined the rhino spoor and the place where the buffalo had wallowed. We took pictures of Treetops from the ground, and finally we made our way back to where the station wagon was waiting.

In another half hour we were once again looking out across the flower gardens of the Outspan Hotel toward Mt. Kenya, standing so high against the sky. Already we were finding it difficult to believe that Treetops had been real and not imaginary.



▲ AN UNUSUAL PORTRAIT OF A PRAIRIE DOG photographed by Russell W. Walker

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June

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1949

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# LETTERS

## Molting Mantis

SIRS:

Recently, while making a series of color slides of various insects for use in the San Diego schools, I noticed that one of my models—a praying mantis—was casting its skeleton. As quickly as I could, I set up a camera for black-and-white shots. The result, as you see here, is rather queer.

In the first picture, the fierce-looking mantis appears to be battling another insect while walking on thin air. But give the photograph a quarter turn and you will see what is actually happening. The mantis is just completing a molt. Its skeleton, which it wears outside its body like other insects instead of inside like ours, is hanging by one leg from the twig, with the molting insect suspended below it. All that remains is for the mantis to unsheath the left foreleg. This operation took considerable effort and necessitated the change of position shown in the other photograph.

W. W. WHEATLEY.

Lakeside, Calif.

## Wholesale Measures Necessary

Sms:

Your interesting article on the Praying Mantis in the March issue of *NATURAL HISTORY* prompts me to inquire how one may introduce these insects into the garden, where you point out they are beneficial.

I tried several years ago to establish them on my 46 x 110 city lot by means of an egg case obtained from a gardener in Ohio. Although we followed instructions, none of the insects ever appeared in our neighborhood. The gardener from whom we obtained the egg case has since discontinued that item. Where can I get some mantises or their eggs?

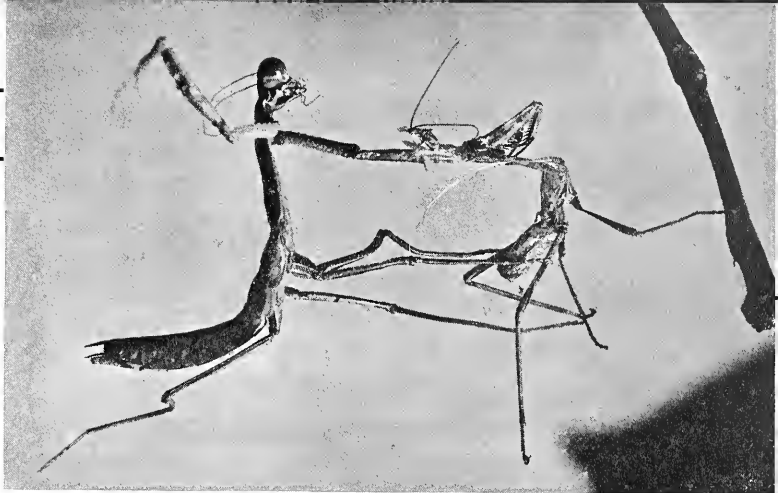
H. J. NOTTAGE.

Portland, Ore.

The following advice is offered by Miss Alice Gray, who is "Official Mantis Keeper" in the American Museum's Department of Insects and Spiders:

I assume that the praying mantis you attempted to establish in your garden was the Chinese Mantis, a very large oriental species now common in the eastern United States. Since there are no recorded native mantises in Oregon, it may be that the climate is unsuitable; but the creatures are hardy, and it seems more likely that your experiment failed through not being sufficiently extensive.

I gather that you placed one egg mass in your yard and permitted nature to take its course. If conditions were favorable, about 200 little mantises would have



▲ NOT TWO INSECTS FIGHTING but a single praying mantis struggling with "itself." Turn the picture one quarter to the left and you will see that its skeleton is suspended from one leg and is sustaining the weight of the struggling insect. The mantis is almost free

► HERE THE POSITIONS have been reversed, and the mantis is doing its utmost to free the one remaining foreleg. Notice the old eye-casing and the skeleton of the antenna. The white "threads" are muscular tissue pulled from inside the old skin

hatched out. Being hungry and active, they would have soon dispersed over a wide area. With average luck, two, or at most three, of them would have reached maturity.

Mantises live only one summer and mate but once. The female devours the male during mating and produces a single mass of eggs. Therefore, even if three of the brood matured, with both sexes represented, and if, with the whole state of Oregon to wander in, they all contrived to meet, only one fertile egg mass could have been produced. This would put you right back where you started. The likelihood of doing even this well is exceedingly remote.

If, on the other hand, you were to introduce a large number of egg masses into a relatively small area, the odd members of the several broods would run a chance of pairing up. The second generation would be much more likely to equal or exceed the first, and the species would be closer to becoming established in the district. If you really want wild mantises in your garden, you will have to use wholesale measures. Secure the co-operation of the neighbors and colonize the entire neighborhood. But first make sure that there is no law against shipping mantises into the state, by asking your State Department of Agriculture. There should not be, since mantises are strictly in-



sectivorous and inoffensive to man and beast.

The egg capsules of mantises are sold by plant nurserymen and by scientific supply houses. Here are a few likely addresses: Butterfly World Supply House, Inc., 289 East 98th St., Brooklyn, N. Y.; Wards Natural Science Establishment, Inc., P. O. Box 24, Beechwood Station, Rochester, N. Y.; General Biological Supply House, Inc., 763 East 69th Place, Chicago 37, Ill. These concerns may keep eggs under refrigeration to prevent hatching. Such retarded eggs would be rather expensive, but the season is too far advanced for you to obtain any other kind this year.

Mantises are reasonably plentiful in the East, but a great many egg masses are needed, and supply house prices are high

even in season. Why don't you postpone the experiment until next spring and arrange to have the eggs collected by an enthusiastic amateur? In winter, when the capsules bulk conspicuously on the leafless twigs, scores or hundreds can be found in a single day almost anywhere within the mantis area. This includes Connecticut, New York, New Jersey, and Pennsylvania. If you have no co-operative friends living in this part of the world, you could put a small advertisement in a winter issue of some magazine read by young naturalists. An unrestricted offer of as much as five cents apiece would probably produce an inundation, so you had better invite correspondence before placing your order.

Have the egg masses shipped while the weather is still cold. Distribute them widely over the neighborhood, since overcrowding leads to cannibalism and starvation. Tie the twigs bearing the capsules securely among the branches of shrubbery, with the convex end of each capsule uppermost. Then all you can do is wait. Even if the experiment is succeeding, you may not know it until the leaves fall, revealing the new generation of eggs. A mantis in its natural habitat is virtually invisible.

If the program for naturalizing the mantis in Oregon sounds too ambitious, you might like to rear a few specimens as pets. Secure a single egg mass and place it in a jar with some moist earth or paper to keep the atmosphere damp. When the insects emerge, liberate most of them, keeping no more than you can conveniently tend. For each of these, prepare a separate cage made of a wide-mouthed bottle with an inch of damp soil in the bottom and a piece of cloth over the top. A branching twig should be fitted into each bottle, so that the mantis will have a place to cling while molting.

Water your mantises daily by sprinkling the insides of the cages. More captive mantises die of drought than of any other cause.

In the city, where no wild food is available, I feed young mantises with fruit flies raised for the purpose. Aphids, or plant lice, from the garden would do equally well. So would almost any small insect except ants. Ants eat mantises. As your pets grow larger, they become easier to feed. They will accept earthworms, caterpillars, spiders, and almost any little creature that is not too shelly. They will even take bits of cooked meat offered with a slight swinging motion to simulate life. Although their appetites are enormous, mantises can go for many days without eating, if they have to.

To lovers of mantises as pets it seems unfortunate that their life span is so short. Even if unmated, they die peacefully of old age at about the time of the first heavy frost.

I hope that this answers your query,

and wish you the best of luck in your study of a most fascinating insect.

### ***Nature's Deep Freeze***

If modern man could step back into the past some fifteen thousand years, more or less, he would find a surprisingly rich and varied mammal fauna in Alaska. He would see not only such mammals as live there today but many others which have disappeared completely from the western world. Mammoths, mastodons, horses, and other mammals which exist today only in the Eastern Hemisphere were just as much North American citizens as the caribou and the moose.

Back in this remote period nature installed a method of refrigeration which has preserved samples of this vanished fauna so efficiently that it is possible today to encounter an occasional animal or part of an animal still in the flesh. Deep deposits of fine silt in the valley of the Yukon have been washed away in hydraulic operations, and these beds are the burial grounds of thousands of Alaska's frozen fauna, usually encountered as bones. From the grass roots down this silt is perpetually frozen, a freeze deep both in space and in time.

On June 13th, a special exhibit in the 77th Street Foyer of the American Museum will show parts of these prehistoric mammals encountered in the flesh in nature's deep freeze. The face and forelimbs of a baby mammoth is the outstanding feature of the exhibit.

The specimens shown are part of the Childs Frick Laboratory collection secured in co-operation with the University of Alaska and the Fairbanks Exploration Company.

### ***Museum Acquires Great Gull Island***

An island with a bright future as a wildlife laboratory came into the possession of the American Museum of Natural History on March 31, when the War Assets Administration awarded Great Gull Island to the Museum at a 100 per cent public benefit discount.

Great Gull lies between Plum Island and Little Gull Island some seven miles northeast of Orient Point, the northernmost of the two eastward-projecting "flukes" of Long Island. It is seventeen acres in extent and has served for more than fifty years as an army fort guarding one of the sea approaches to New York City. Prior to 1898, the island was the site of a thriving tern colony estimated at 7000 birds. It was here that the late Frank M. Chapman made his first field expedition for the American Museum in the summer of 1889. Following this visit, and at Dr. Chapman's suggestion, the Linnaean Society and the American Museum arranged for warden protection of the island's sea birds, until the colony was destroyed by the building of Fort Michie.

Great Gull is also notable as the former home of the little-known and now extinct Gull Island mouse. It is ideally situated for ornithological studies, offering fine fishing grounds for sea birds on all sides and being located on a well-known autumn migration route for birds crossing to Long Island from the Rhode Island coast.

Although the Museum will have title to the island, the Linnaean Society of New York has volunteered to plan and carry out research work and assume the costs of administration. A "Gull Island" Committee has been formed to direct operations, with Christopher K. McKeever, well-known Long Island ornithologist, as chairman. Museum members of the committee will be Dr. Robert Cushman Murphy, Chairman of the Bird Department, Dr. Lester Aronson, Chairman of the Department of Animal Behavior, and Richard H. Pough, Curator of Conservation.

Immediate plans for the island center around the effort to establish the common tern as a breeding bird once again, and this summer experiments with decoys will be carried out. Some changes in the island will probably be necessary, such as demolition of certain army structures and the planting of trees and shrubs, but this work will be delayed until the breeding season is ended.

Later work may include banding and other migration studies, bird behavior studies, and possibly efforts to induce other species such as the osprey, petrel, and eider to nest on the island. Population research on small mammals is being considered, and several eastern universities have expressed interest in the island as a site for other natural history studies.

Deserted and desolate now, Great Gull Island seems destined to a busy and useful future as a field laboratory and research station.

ROBERT S. ARBIT, JR.,  
President, Linnaean  
Society of New York.

### ***End of the World at Hayden Planetarium***

During July and August, visitors at the Hayden Planetarium will have opportunity to witness a graphic program on the question of the ultimate fate of the planet Earth. Will the Earth someday freeze when the last atom of energy leaves the Sun? Or may we experience the dread catastrophe of a cosmic collision? These and other questions will be thrillingly discussed.

Through June, the subject of the Planetarium show will be "Our Daytime Star—the Sun." Fountainhead of life and energy on the earth, the sun is by far our most important star. The Planetarium show brings vividly to mind the important role it plays in almost every aspect of our existence.

# NATURAL HISTORY

*The Magazine of the American Museum of Natural History*

F. TRUBEE DAVISON, President

WAYNE M. FAUNCE, Vice-Director  
In charge of Publications

ALBERT E. PARR, Director

VOLUME LVIII—No. 6

JUNE, 1949

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EDITOR: Edward M. Weyer, Jr.  
Elizabeth Downes, Editorial Assistant.  
Atherlie E. Karp, Editorial Assistant.

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# YOUR NEW BOOKS

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## ECUADOR AND THE GALAPAGOS ISLANDS

- by Victor Wolfgang von Hagen

The University of Oklahoma Press, \$3.75  
290 pp., 17 photos, 3 maps

IN the author's words, this book is an "... informal history, told through the personalities of those who have traveled, lived, written, or died within the land of the republic on the Equator." It also contains a liberal sprinkling of natural history and ethnology, all of it related in von Hagen's briskly paced, though occasionally florid, style.

The history is lively and colorful, and the author's knowledge of it is clearly based on extensive research. The reviewer was less satisfied, however, with von Hagen's treatment of the contemporary highland population—particularly the Andean Indians and the cholos, or half-castes. Throughout this section "race" is confounded with "culture" in an alarming manner, and the resulting confusion detracts, inevitably, from his picture of Ecuadorian society. This is doubly unfortunate since von Hagen implies that what he describes for Ecuador is true of the Andean republics generally.

In dealing with the Colorado Indians, and with the head-hunting Jivaro of the Amazonian jungle, von Hagen is on firmer ground, since his knowledge of both tribes is based on first-hand investigation. In describing the fear-ridden head-hunters, the author explodes the myth (if it still needs exploding) that the primitive is a Rousseauist "natural man."

The high point of the book, in the reviewer's opinion, is the section on Ecuador's desolate island outpost, the Galápagos—long a haunt of pirate, whaler, naturalist, and romantic escapist. The history of these "cinder heaps" is traced from their accidental discovery by Spanish explorers to the occupation of the islands by the United States Navy Air Force during World War II. Two chapters are devoted to Charles Darwin; it was his experience with the unique fauna of the Galápagos, von Hagen maintains, that

led the great naturalist to propound his theory of evolution.

The book is well illustrated and contains a very useful bibliography.

HARRY TSCHOPIK, JR.

## CREAM HILL

----- by Lewis Gannett  
with lithographs by Ruth Gannett

The Viking Press, \$3.50  
191 pp.

ON any highway leading from a large city to the rural countryside you will see them, these people of the week-end world. They travel in cars packed to bursting capacity with their belongings. Representing every class and station in life they come in conveyances ranging from modern super station wagons to rickety old jalopies, but all have one object in view—to reach that shack or cottage in the country in as short a time as possible. The exodus from the city starts in earnest Friday afternoon and increases in volume until Saturday night. The week-end countryman is a modern or new kind of being that is the product of the automobile. He is, as he needs must be in some ways, eccentric. Anyone that will work at a job all week and then spend his rest days at manual labor, pestered by a host of tormenting insects and inconveniences, could hardly be considered exactly normal. The choice location is an old homestead of medium proportions that can be renovated and made livable for week ends. The more dilapidated it appears the greater the appeal to prospective purchasers. During the past ten or fifteen years every available shack within two hundred miles of New York City has been singled out and commandeered by someone. With increasing competition, prices have risen from a few hundred dollars for a twenty-acre tract up into the thousands.

When Lewis Gannett bought a homestead on a Connecticut hilltop twenty-five years ago he got in on the ground floor and was one of the privileged few that had a wide choice in selection. Strangely enough, he found that his great

great grandfather had been a settler on this very hill. From his experiences in making the house livable for week ends, linked with personal past history, Mr. Gannett has written this entertaining and useful book that will delight the country-minded. It is a book that the city reader will also enjoy, and the week-end will find it most helpful in developing the background of his own particular estate. In this interesting narrative is told how year after year Lewis Gannett and his family slowly learned with changing experiences. Eventually they came to intermediate terms with the hilltop, its people's past and present, its plants and trees. As most readers are already aware, Lewis Gannett is a world traveler with broad experience and has traveled all over Europe, visited Russia and the Orient. He now lives in New York when not vacationing at Cream Hill.

GEORGE G. GOODWIN.

## HIGH JUNGLE

----- by William Beebe

Duell, Sloan and Pearce, \$4.50  
379 pp., 49 photos

*HIGH JUNGLE* is the twenty-second book written by William Beebe. Like the others, it is an account of observations in the field, the mental impressions they invoke, and the philosophical asides in which the author may discourse on a surprisingly wide range of topics. This book is based upon field work in Venezuela, mostly during residence at Rancho Grande, and covers a period including parts of 1945, 1946, and 1948.

As always, William Beebe plans his work well, is accompanied by a competent staff, and brings back masses of material. The area worked in this case is a rich one; Rancho Grande is in a tropical rain forest, a high jungle in the fullest sense of the words. Also the party had ready access to other environments ranging from the waters of the Caribbean to dry and desert conditions. The field of interest was comprehensive, and nothing escaped attention from the highest to the lowest animal or plant. One moment the author may be noting the ubiquitous vulture on high aerial patrol, the next turn-



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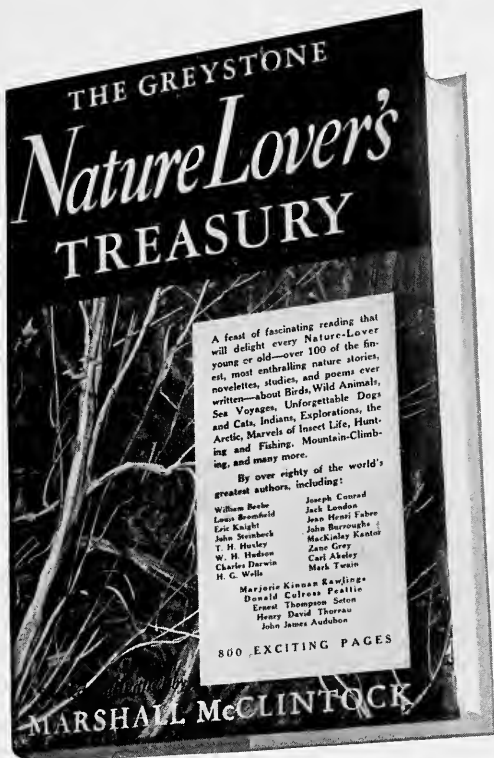
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ing some logs for subterranean encounters.

This inquisitive turn of mind, this readiness to explore even the most trivial (to a casual observer) contact with nature, provides William Beebe with some surprising data. All the aids of modern science are called into play, from high power telescopes to compound microscopes. No creature he meets can, therefore, feel a secure sense of privacy. Like Helen of Troy, he may expect to see his private life exposed in print.

"Although we were one yard away, no slightest doing, no casual or intentional activity was hidden from our prying eyes, no intimacy was foreign to our gossip sheet." From the chapter "Private Lives of Jungle Falcons."

Although some space is devoted to the higher vertebrates and to events that would impress the veriest tyro, of which a landslide is a good example, a great many pages are devoted to lesser creatures, less obvious happenings, and episodes outside the experience of practically every reader. Because of this wide coverage of subject matter, the average reader may find his interest waxing and waning as the topics vary. This reviewer noted that reader appeal, for him at least, was a fluctuating quality.

The book is well illustrated with excellent halftones.

H. E. ANTHONY.

## PILCHUCK: THE LIFE OF A MOUNTAIN

----- by Harry W. Higman  
and Earl J. Larrison  
Drawings by Edmund J. Sawyer  
Superior Publishing Company, Seattle  
\$3.50, 281 pp.

WELL might we envy a man whose work brings him in intimate association with a mountain for six years. But we who have more prosaic things to do can be grateful that he and his companion have given us a delightful account of the mountain and the abundant life they found on its broad, forested slopes.

One of the authors, Earl J. Larrison, is a young biologist. For his doctorate in the Laboratory of Vertebrate Biology at the University of Michigan he elected to study the ecology of a single mountain from base to summit. He chose Pilchuck Mountain on the western edge of Washington State's Cascade Range, 33 miles northeast of Seattle. There, in an area five by eight miles, Larrison and Harry W. Higman, mountaineer and outdoor enthusiast, ranged from dripping, evergreen "rain forest" at the base to the mile-high, wind-battered crest at timber line—and together they wrote this story.

The authors invent three likable characters, led by "Doc," a biologist, who

manage to communicate to the reader the fascination and excitement of discovering the amazingly diverse plant and animal colonies that make a mountain a little world in itself. They found 52 kinds of mammals and over 50 different plant associations, discovered 75 small lakes, and describe in easy, nontechnical language their personal experiences with animals, birds, weather, camping, forests, bogs, cirques, and even ferns, mosses, and lichens.

"Doc" is a much-needed public relations man for biologists. Although slightly didactic, he clearly explains the interrelated life cycles of plants and animals and the importance to man of maintaining some semblance of the original "balance of nature." But Pilchuck, like most of the remnants of our once great wilderness, is a last-ditch stand against the encroachments of civilization. Can the pitifully few "Docs" convince Americans how vital it is to save some of our wilderness heritage in time?

WELDON F. HEALD.

## THE WAYS OF A MUD DAUBER

----- by George D. Shafer

Stanford University Press, \$2.50  
78 pp., 10 plates (4 in color), 10 figs.

MANY an inquiry addressed to the American Museum's Department of Insects and Spiders is: "How can I get rid of them?" This sort of question is asked not only with reference to insects that are destructive or uncleanly but also with regard to bees and wasps that are essentially beneficial. Those more concerned with the possibility of now and then being stung than with the opportunity of making interesting observations may acquire a new viewpoint in reading this book. It was written by a retired professor of physiology who at the age of 75 intrepidly feeds wasps with drops of honey placed on his finger and has enough fellow-feeling for these creatures to go to the trouble of replacing a broken wing in one crippled individual with a whole wing derived from a dead specimen of the same species.

This act of surgery failed of its objective, but the disabled *Sceliphron cementarium* repaid its would-be benefactor by revealing many of the techniques of its specie. It became a "caged animal," supplied by its "keeper" with building material for its cells and with prey in the form of spiders, and it performed under his very eyes.

Observations on structurally perfect specimens of the mud dauber were also undertaken in number—in fact, the study was extended over five years—and the author was enabled to make new and valued contributions to our knowledge, notwithstanding the fact that *Sceliphron* is one

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# "Field Books"

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# Nursery of the Gray Whales

By LEWIS WAYNE WALKER

*Photographs by the author except where otherwise credited*

FEW animals in the history of American wildlife have been lost and found as often as the California Gray Whale in the hundred years since its discovery. Although its weight of 20 tons and length of 50 feet makes this whale plainly visible on a broad expanse of ocean, it has apparently disappeared on three separate occasions.

Postglacial skeletons in Europe, including one that was found when the mud of the Zuyder Zee was being drained, indicate that the Gray Whale was formerly native to the eastern Atlantic. And, if some old whale drawings, presumably American, and vague descriptions of "Scragg" whales can be used as circumstantial evidence, they may once have occurred along our eastern seaboard.

A century ago it was estimated that these marine mammals passed San Diego at a rate of "a thousand a day" in a southward migration that continued practically unabated for a full three months. This abundance was followed by relentless persecution and then by virtual disappearance. It seemed that this shore-loving species was doomed, and even Captain Scammon, a man

with the peculiar attributes of a whaler, a great naturalist, and the exploiter of the whales' breeding grounds, forecast their inevitable extermination. Less than a quarter of a century after the publication of his book on marine mammals, the Gray Whales were thought to be extinct along our western coast, and for several decades scientific mention of the species was generally couched in the past tense.

Their next reappearance in the early nineteen hundreds was far to the west and many thousands of miles away. Dr. Roy Chapman Andrews was studying the unknown whales of the orient and in his research, descriptions of some mammals that twice yearly passed along the coast of Korea reminded him of the lost Grays—not only in physical characteristics but

also in temperament. These rumored whales were devoid of dorsal fins. They were coastal in habits, and the translation of their Japanese name was "Devil Fish," the identical term used years before by whalers of California and Mexico.

Soon after his arrival at a distant Korean whaling station, village whistles summoned townspeople to the docks, and under the wavering shadows cast by flares, Dr. Andrews saw a tremendous carcass on an incoming boat. It was a California Gray, beyond a doubt; and in the weeks that followed, scores of the dead mammals were brought to port where their carcasses were rendered for their oil and stripped of their edible meat. Many were measured, and a few skeletons were preserved, for it was then surmised that the species might be on the

"way out" even on Asiatic shores.

Rediscovery of these lost animals presented peculiar problems of migration and range. Korea was thousands of miles from the whales' established home, and according to previous concepts the Grays were coastal mammals and not denizens of the deeper parts of the Pacific. Had the whales crossed to oriental shores in the recent past, perhaps forced by the incessant pursuit of the American whalers? If so, had they gone directly across the deepest of all oceans or by the long northern route by way of the Aleutians? Or had the species been split for eons into two separate bands—one frequenting the coast of Korea, the other formerly resident along the coasts of California and western Mexico? These questions have never been definitely answered. But again, if we may rely on the sketchy

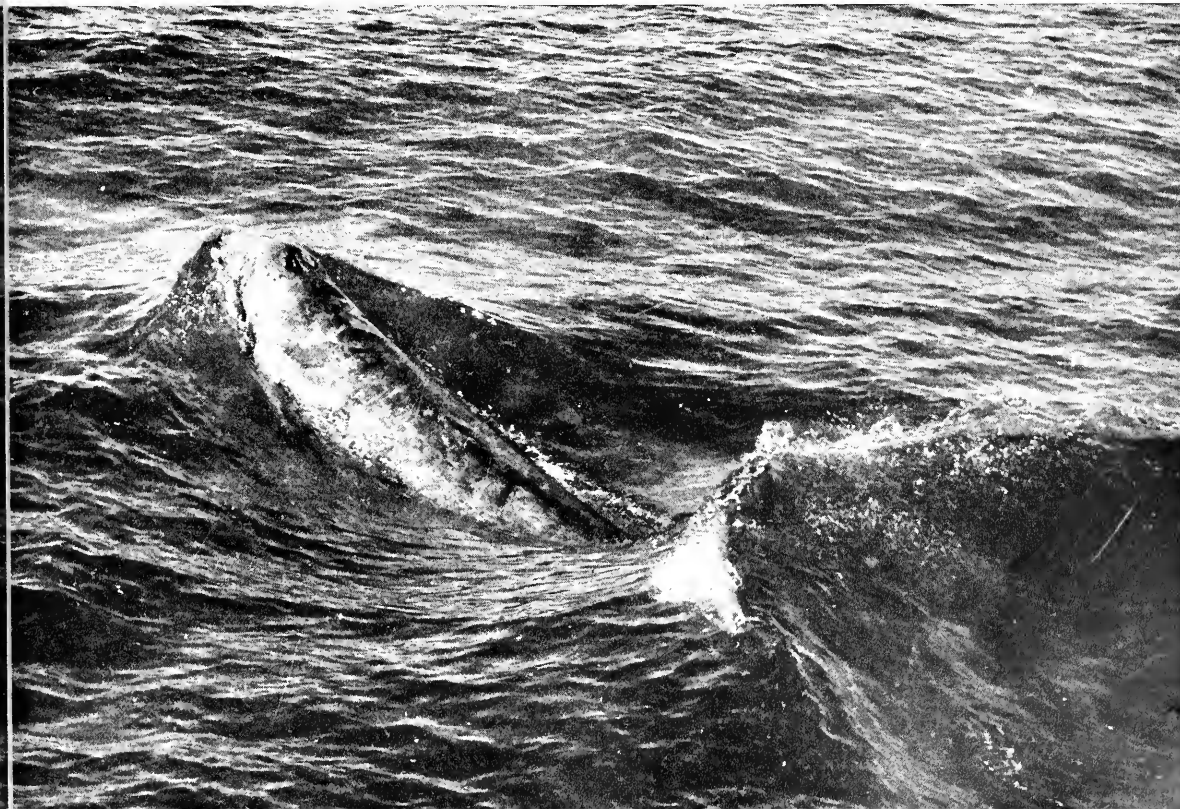
evidence of century-old paintings, credence is given to the two-band theory, for there are some ancient Japanese prints that portray animals having most of the characteristics of Gray Whales.

Until the end of the last war it was believed that Japan had a complete monopoly on "Devil Fish" and that our band had been extirpated from former haunts. But when Dr. Carl Hubbs joined the staff of the Scripps Institution of Oceanography, another chapter on the elusive California Grays began to unfold. A gigantic whale hunt began—a hunt wherein not an animal was killed but which probably called into operation the most imposing array of equipment ever used in the study of a single species of wild creature.

It all started on a small scale when students manned field glasses

▼ ONE OF THE ELUSIVE CREATURES, probably a calf, photographed from a hovering helicopter. The Gray Whale reaches a length of 40 to 50 feet and a weight of 20 tons. Ruthless commercial slaughter was thought to have exterminated them in the last century

▲ WHEN the expedition's helicopter was downed by a dead battery, a message for help, spelled out with turtle shells, brought relief. The battery was dropped by improvised parachute



from lookouts on the Institute roof on the cliffs at La Jolla. From this vantage point they counted the number of whales passing during specific periods of time and charted their routes on shore-line maps. Their findings, published in newspaper articles, aroused the interest of local citizens, and observations from amateur naturalists up and down the coast poured in. After correlating these scattered bits of data, Dr. Hubbs was able to forecast the arrival of a group of whales seen hours before far to the north. In this way, routes of travel and cruising speeds of six or seven miles an hour formed into definite patterns, as an astounding total of 200 whales were counted during daytime hours between December of 1946 and February of 1947.

During this same period there were constant reports of alien submarines in offshore waters, but investigation usually disclosed creatures that blew 20-foot geysers three or four times in rapid succession and then submerged for about seven minutes. As a result, in cooperation with the Navy some attempts were made to tabulate movements with the use of underwater sonar. The government's primary interest was based on identification, while Scripps Institution hoped to determine the numbers that passed nocturnally. This modern phase of investigation unfortunately started after the migration's peak, and so it met with only mediocre success. But the fish and flotsam that registered on the delicate instruments indicated that re-

sults might be secured when the passage was at its height.

Additional naval co-operation is scheduled for some future date when an effort will be made to determine the type of communication used by whales. During the La Jolla observations, groups of the cetaceans were often seen to submerge and rise almost simultaneously although separated by at least a quarter of a mile of open water. This occurred too frequently to be mere coincidence, and Dr. Hubbs feels that delicate instruments may make audible some sort of whale signal—perhaps in the supersonic or perhaps in a very low frequency. Porpoises, small cousins of the larger cetaceans, utter a constant series of piglike squeals and grunts when feeding and traveling.

By late January the southward movement had reached its peak, and it was plainly evident that the migration could no longer be looked upon as just a few survivors of an almost extinct animal to be watched, recorded in scientific journals, and then virtually forgotten. Instead, the numbers had taken on such magnitude that the creatures were potentially valuable to both the United States and Mexico. Thus the study abruptly changed from one of purely academic interest to a vitally important research project with an international bearing. Help of the Coast Guard was requested, and this branch of the service co-operated by granting Dr. Hubbs permission to be an observer on a few of their southward mercy flights. Thus in February of 1947,

Scammons Lagoon, a famous place in American whaling history, was scanned with powerful glasses from the plastic nose of a P.B.Y. Far below, 101 whales were counted swimming in the winding channels and in the surf at the entrance to the lagoon. Even at that early date some of the cows were accompanied by a single newborn calf.

Before this Mexican inlet was found by Scammon, it teemed with breeding whales, calving and nursing their young undisturbed. However, about 1850, Scammon's boat chased some whales into the breaker line on the edge of the desert that forms Sebastian Viscaino Bay. Although the water was shallow and dotted with sand bars that precluded deep dives, the quarry mysteriously disappeared. Search for the animals disclosed a narrow channel running between the breakers paralleling the beach and opening into the whale-choked lagoon, now bearing the Captain's name.

For several years, Scammon successfully kept this valuable location secret, and his boat, the brig "Boston," with its share-paid crew, was the envy of the fleet. It would make a trip around the Horn and return with a load of oil in a few months, a decided contrast to the two- and three-year antarctic journeys made by other New Bedford vessels. According to rumor, however, the secret was divulged in a peculiar way. Another whaling craft sailing north of Cedros Island detected on an offshore breeze the distinctive odor of blubber being rendered. This scent, stronger with every minute of progress, led the strange boat to the breaker line and enabled a lookout in the crow's-nest to see the masts of Scammon's ship over the large white dune that marks the lagoon entrance.

News of this marine treasure spread rapidly, and the next spring found 40 or 50 ships jockeying for the best channel positions and har-

Photo by G. E. Kirkpatrick



◀ THE EXPEDITION'S temporary camp overlooking San Ignacio Lagoon, the nursery of the Gray Whales





▲ THESE UNPRECEDENTED PICTURES of the Gray Whale were taken from the helicopter, here seen hovering over the wake of one of the huge creatures

pooning every passing whale. The slaughter was not only easy but thorough. Floating flag-marked carcasses dotted the placid waters, which soon became red with the uncontrolled butchery. With almost every kill a suckling calf was left to die as an orphan, and within a few years it no longer paid the whalers to venture into the plundered nursery.

A hundred miles beyond Scammons the Coast Guard plane carried Dr. Hubbs over San Ignacio Lagoon. Here a count of 67 whales was recorded, and a few hours later, after an injured fisherman had been taken aboard, 94 were tallied on the return over Scammons. Although this flight was hurried and inconclusive insofar as accurate numbers were concerned, it proved that the whales had returned to haunts vacated long ago. Thus tentative plans for a future expedition, heretofore based on mere theory, were considerably strengthened.

Several of these southern trips were made. Meanwhile, observations continued at La Jolla, where a constant stream of visitors watched the whales as they traveled

a narrow, invisible path that took short cuts from point to point. Occasionally the animals were seen to twist about in peculiar gyrations with flukes exposed, leisurely thrashing the water. The significance of this maneuver is unknown. Perhaps it was just a stretching of muscles, tired from the straight, headlong monotony of their swim from the arctic. Perhaps it was a

phase of courtship unseen by us because most of their bodies remained a score of feet below the surface. Sometimes one of the tremendous animals would jump completely out of water, landing with a resounding splash. The reason for this action is also unknown but is believed to be caused by the need to take visual bearings or by the irritation resulting from the barnacles that stud their broad backs.

A few individuals of the numbers passing the Institute strayed from their route and ventured near shore, becoming temporarily lost in the maze of kelp. Yet despite the fact that both Oriental and American whalers formerly considered "Devil Fish" the most dangerous of cetaceans, these baffled animals rarely attempted to use their tremendous strength to break a path through the seaweed. Instead, they just swam about the clear areas aimlessly, eventually blundering upon exits leading into deeper water.

During this first spring, the University of California's research yacht, the "E. W. Scripps," was made available for offshore work and was tentatively scheduled for a



➤ OCTOPUSES were caught by hand in crevices about 15 feet below the surface. When correctly cooked, they resembled the meat of the abalone

Mexican cruise if financial backing could be procured for the expedition. Here a friendship of long standing between Professor T. Thompson Flynn, biologist of the University of Belfast, North Ireland, his son, Errol Flynn of Hollywood, and Dr. Hubbs prompted the actor to assume the expenses for such an expedition, then set for the following year.

The schedule, planned by Dr. Hubbs and Errol Flynn during the remainder of 1947, worked to perfection in its rendezvous midway between the lagoons. Slow trucks, slightly faster boats, one helicopter with limited range, and five speedy planes were synchronized into an effective unit and reached the distant point according to schedule. The truck camp was established and ready for occupancy at Punta Abrejos lighthouse when the yacht came into sight. At almost the same instant we heard the drone of approaching planes. These had left San Diego three or four hours before, flying over a cactus-strewn territory that had taken us a full week to cover by truck over practically nonexistent roads.

The meal that first night was completely indigenous. Merely what the region provided gave us a truly bountiful repast. Five minutes of barefoot beach scratching had uncovered half a sack of four-inch Pismo clams, while Coyote Lagoon, a small inlet a few miles away, had an abundance of mangrove oysters of two delectable species of bivalve, which we actually picked from the roots of trees.

Mangrove thickets border most of the lagoons in this section of Mexico and are usually established where the plants will be completely out of water at the lowest tides. The roots, however, drop from high tide level like a series of stilts to form an impenetrable leafless jungle, creating the unique oyster beds of the region. In some spots where current and other conditions are ideal, a single root will support several layers of delicious oysters, to be harvested with a machete or ax, instead of with a rake.

Several aspirants to membership

in the "Bottom-Scratchers" (an exclusive club of Southern California's expert goggle fishermen) were student seamen aboard the "E. W. Scripps," and they retrieved sea food delicacies from underwater that were not available along the shore lines. Almost every time these swimmers bobbed to the surface they would have large abalones stuck to their chests or would be clutching struggling lobsters or octopuses removed by hand from crevasses ten or twelve feet below. Bert, the cook, watched the larder grow, first with anticipation, then with dismay, as it became higher and richer with each passing minute.

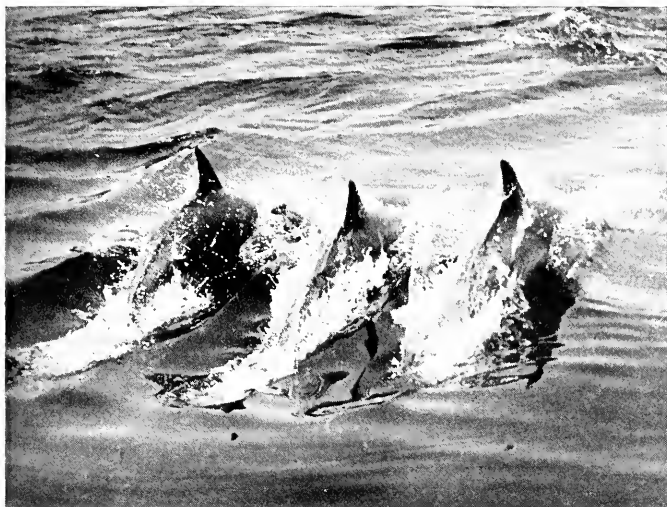
Reconnaissance flights the next morning radiated from the lighthouse and covered both lagoons in an endeavor to select the best spot for the actual whale observations. The broad expanse of Scammons was well populated even though it contained but a fraction of the number of whales that had frequented the spot a century ago. If our planes had been amphibious, this lagoon would have been our choice, but low-flying land planes beyond gliding distance from shore presented dangers we did not care to court. The long and narrow San Ignacio Lagoon was more inviting, and we selected a dry tidal flat on its eastern beach as a temporary campsite for the helicopter. This machine, owned by Paul Mantz, three-time winner of the Cross-Country National Air Races, had been delayed by a weather clause in a movie contract but was due to arrive within a few days. In an endeavor to have the new location ready for work, we made our first mistake.

Mangrove stumps, salicornia, and other vegetation created hazards on the proposed San Ignacio tidal flat runway, and the entire personnel of the expedition was required to make it safe for the heavy cargo planes that were to transport gas, gear, and grub. On our departure from the lighthouse (our pre-arranged meeting place), a note and map were left for the helicopter crew, describing the location and

directing them to a beach a half mile away, where one of us and a cache of gasoline awaited their arrival. By midafternoon the new strip was leveled, and the workers walked to the planes warming up on the desert clearing near by. At approximately the same time, the lookout at the beach gas depot saw the helicopter drop out of the sky, hesitate while the note was read, and depart a moment later in the direction of San Ignacio Lagoon.

Somewhere en route the airborne "windmill" passed the north-bound planes, and when it arrived over the new strip, found the spot deserted. Other mud flats of similar nature had been passed on the way, hence both pilot and mechanic concurred in the belief that there might have been a last-minute change of location. Gas was running low, but a faulty generator made it imperative to keep the motor in operation. A 20-mile search for a camp not yet established used the remaining fuel, and a forced landing was made on a lonely point. Then, according to the papers, the helicopter was "Lost in the Wilds of Mexico!"

Seventeen hours later, after a long search, the helicopter was located almost by chance and at a time perilously close to the deadline set for notification of the Coast Guard. One neck of land projecting into the lagoon had been by-passed, and before giving up, Dr. Hubbs suggested a quick look "to be sure we have covered the area." The plane was turned, and soon the grounded helicopter was seen dead ahead. G. E. Kirkpatrick, San Diego Zoo photographer and pilot of the search plane, blew a tire on the landing, and while he cleared a runway for an attempted take-off, Dr. Hubbs gave the famished helicopter crew a lesson on survival. Their only food in over 24 hours had been a light lunch packed in the States, and the last of their water had gone some hours before. After Kirkpatrick's hurried departure to prevent search by the Coast Guard, they remained worried until it was demonstrated by Dr. Hubbs that the oysters and clams were not only edible but very good.



▲ A TRIO OF PORPOISES in perfect formation

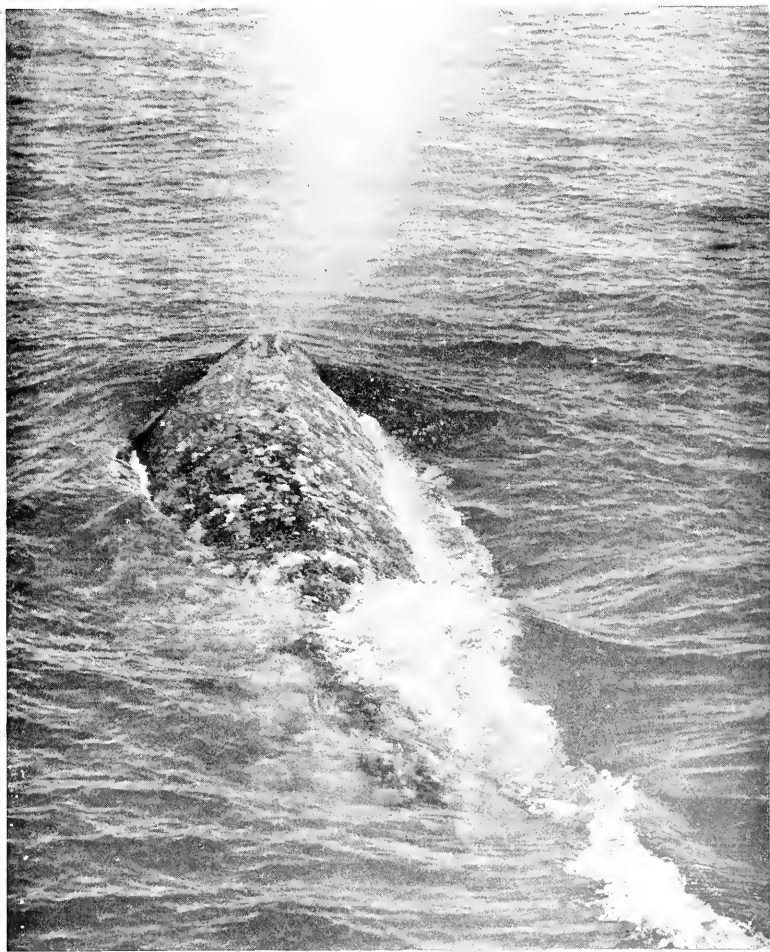
bits of junk can build!" The Cub's battery was placed in the center of a cardboard carton that was stuffed with seaweed. This was wrapped in bedrolls and then tied on the underside of the canvas.

Later that afternoon seven of us crouched around the open hatch of the cargo plane as it circled the stricken helicopter. Bill Murray, ex-Army Air Force Colonel, called directions as he banked in for the crucial run. At his command, cargo and canvas were shoved into space. This was our first attempt at spot-bombing, and with the proverbial beginner's luck it almost finished the helicopter. We watched the battery hurtle directly toward the ma-

Several hours later a five-gallon can of gasoline padded with a mattress was dropped to the helicopter. This fuel was placed in the tanks, but the weakened battery failed to start the motor. More hours passed. The next time the marooned machine was circled, the crew of the cargo plane saw the words NEED BATTERY spelled out in twelve-foot letters composed of large sea turtle shells gathered from the shore line. The dead battery really complicated rescue plans. The Cub's battery could have been substituted, but this craft was grounded with tire trouble, and the expedition had no other conveyance suitable for a landing on the lonely point. Although doubtful if the battery would stand an aerial delivery, we set to work designing and making an improvised parachute. If this rescue project were to fail, a 1500-mile replacement flight would be necessary, and at least a day's observations would be lost.

When the ten-by-ten tarpaulin was finished, a motley collection of ropes, cords, and hausers hung from the four corners, and its primitive appearance prompted the remark, "Yes sir, the best that brains and

▼ CALIFORNIA GRAY WHALE BLOWING. A rainbow is sometimes produced in the vapor expelled from the two blowholes. Barnacles are visible on the back





◀ OYSTERS THAT GROW ON TREES.

At low tide, thick clusters of the shellfish were exposed on the roots of the mangroves, providing a welcome addition to the expedition's commissary

▼ AT HIGH TIDE, the oysters were underwater, and the mangroves looked like low shrubs

chine we were trying to save. In the five or six seconds of its descent we duplicated, high in the air, the same muscle-straining body-English used by the grounded crew, in an effort to have the heavy cells miss one of the projecting rotors. Fortunately, the helicopter was not hit.

After rendezvousing at the base camp, the remainder of the afternoon was spent on mechanical work, even though whales and their diminutive cousins, the porpoise, could be seen blowing offshore in a tantalizing manner. The drone of planes and the strange sight of the helicopter's return at its forced landing had the effect of primitive tom-toms in calling natives to council. By dusk a score of curious turtle fishermen, the lagoon's only human inhabitants, arrived at our base. Some had walked barefooted many miles over the cactus-strewn desert. Others arrived by burrow, and a few had *pongas*, or rowboats, pulled up on the beach. These fishermen, who eked a living from the waters harboring the whales, were voluble with information gleaned in past years. They pointed out the localities where the greatest concentrations could be expected, and in many other ways were of invaluable assistance.

The first reconnaissance flight consisted of a speedy trip around the shores of the lagoon. At the mouth where the ocean breakers were pounding against barrier sand bars,



the channels were dotted with whales. The majority of them seemed large and were not accompanied by calves. In the days of Scammon, most of the animals killed at the entrances to the lagoon were bulls, and according to his theory the males only ventured into the lagoons for quick breeding forays with cows that had just given birth to young.

However, the central channel, which ran far into the desert, seemed to be the main arterial highway, with a steady stream of family groups traversing its blue ribbon of deeper water. Of the scores of whales below, very few were seen swimming up the lagoon, but many were heading in the direction of the Pacific. Subsequent trips disclosed that they more or less followed the tides—up on the incoming, back on the outgoing.

From the vantage point of the

hovering helicopter, this tendency of one-way travel emphasized an odd trait that probably would not have been noticed from a surface craft. With but few exceptions, mothers with calves were on the right-hand side of their offspring, and in the next few days we found this to be the usual position when the whales were undisturbed. However, when we hovered ten or fifteen feet above their backs we could drive the calves from side to side, but there were occasions when we saw the mother definitely shield the offspring with her body, slowing her speed if the young lagged behind.

Turtle fishermen became constant visitors, and they talked about the raids of killer whales that sometimes entered the lagoon. According to their observations, a mother Gray Whale would occasionally slip under a calf and place her body



▲ GREEN TURTLES caught by the Mexican fishermen, who alone frequent this desolate section of the coast

between it and the killer in an endeavor to protect it from these fierce, 20-foot marauders that will successfully attack animals four times their length. They also reported that the mother would sometimes lift her calf partly out of the water with her offside flipper. Aside from these maneuvers, our informants stated that the Grays made no attempt to fight off the orcas but just seemed resigned to their fate.

On the first few flights it was obvious that the nearness of the helicopter disturbed the whales, causing them usually to seek deeper water. However, by hovering behind and to one side, we found it possible to herd the animals in any desired direction, and before long subjects to be photographed were being coaxed into shallow stretches where deep dives were impossible and where muddy trails lingered as sinuous paths against the normal blue of the lagoon. After this had been done a few times, we noticed a decided change in whale temperament. Instead of swimming along in a placid manner, some of the Grays churned the water with flukes and fins until their wakes became swirling cauldrons of foam. Before such displays of angry power, the pilot invariably lifted the craft to a safe 25 or 30 feet. It was easy to visualize the small-boat wreckage of a century ago—crew spewed into the water and at the complete mercy of barnacle-studded tails and flippers of the enraged animals.

From a distance some of the blowing Grays appeared to be almost white, but closer scrutiny disclosed that the effect was caused by a solid layer of barnacles. These shellfish more or less completely covered most of the older animals. Newborn calves, which seemed to be about fifteen feet in length, were a glossy gray-black without the scars and barnacles that marred the skins of their elders. A few of the helicopter observers reported seeing their whiskers—short, bristly hairs that protrude around the mouth area.

On our arrival at San Ignacio Lagoon the Mexican fishermen scoffed at the traits of meanness so often ascribed to the whales in the works of Scammon, and they rowed their *pongas* through groups of whales with impunity. The large beasts usually scattered at their approach. However, after the elusive helicopter had pestered the whales for a full week, they evidently became more like the "Devil Fish" of old. On my last day in the lagoon, cleaning up campsites and paying off debts incurred by the expedition, a boatload of excited natives hurried to the command car and told of the persistent attack by a mother *ballena*. They had been crossing the channel to reset turtle nets and barely gave a second thought to a whale that submerged after a noisy blow. Suddenly, however, they were thrown from their standing positions at the oars, and

they saw a giant whale nudging the stern of their *ponga*. The initial strike was the hardest of the attack, and they felt that the boat's combination of flat bottom, extreme buoyancy, and small size was all that prevented a cave-in of the stern. The whale continued to batter and nudge as oars were used on her broad nose to push the craft shoreward. She only desisted when the water became so shallow that her wake was a ribbon of brown mud.

Occasionally some of the whales tarry too long in the shallows and become stranded by lowering tide. Unlike most other cetaceans, however, which die when there is not enough water to cradle their great weight, the Grays are able to survive and take to the water with the next rise in level. Curiosity prompted the turtle fishermen to open and examine one whale that died in the lagoon, and they reported buckets of sardines in the carcass. Until the Flynn-Hubbs study, very little was known about the diet of the Grays at the southern end of their range. Scammon believed they spurned food when about the nursery, but he did report the occasional finding of sea lettuce in their stomachs—a decided contrast to the information that we gleaned from the fishermen.

Comparatively little is known about the breeding cycle of the California Grays. Adults harpooned on their leisurely northward trek from the lagoons contain fetuses that are extremely small, due to recent impregnation, but scanty records of whalers report embryos twelve feet in length taken from cows on the southward migration. This would seem to indicate that each productive cow gives birth every year, although some authorities believe that the breeding cycle is a two-year affair. If this latter assumption is correct, future investigations will probably disclose a band of nonbreeding or resting cows in some other locality. Practically all that we saw in the lagoons were accompanied by newborn offspring, and the few barren individuals were probably two-year



olds just reaching full maturity.

The growth of the young is truly phenomenal. Born between twelve and seventeen feet in length, they reach over twenty within a month, when they head for northern waters. The winter following the spring of their birth they return to the south as yearlings, almost full grown but not ready to propagate until another season has passed.

By International Whaling Agreement, protective laws were passed on the Grays in 1936, and all countries enforced them except Japan, in 1937. Killing continued in the orient until 1942, but all countries are now adhering to the international covenant. It thus seems that the future of the Gray Whale is secure and that conservation measures were effected in time. However, even the small concentrations seen from the helicopter represent untold wealth, not to smugglers, as in the days of the illicit fur seal pelts, for 20-ton animals cannot be smuggled conveniently, but as a monetary goad to a sudden repeal of protective laws.

When we consider the tragic history of these whales—in Holland, along our Atlantic coast, off California, and in the orient—it is plain that they are vulnerable, and at present anything short of complete protection would be disastrous. Although their population is now on a rapid upswing, there is still no surplus for harvest. With modern killing devices, a single season of pursuit could force the Grays into their fourth disappearing act—one from which they might not return.

At present, both San Ignacio and Scammons should be set aside as temporary sanctuaries until practical conservation plans are formulated. Some day, perhaps within the next decade, these cetaceans will reach the saturation point, just as the fur seals have done on the Pribilofs. Then the population will level off, and any excess can go toward the needs of man. But protection should certainly be continued until their numbers once more approach the "thousand a day" of less than a hundred years ago.

# Insect THERMOMETERS

Know the insect orchestra and  
you can clock the temperature

By CLEVE HALLENBECK

"I WONDER if it's cool enough for a jacket?" inquired a young woman at an evening lawn party last summer.

"Just a minute," I volunteered, "and I'll give you the temperature."

I gazed at my watch a few seconds, then advised her, "The temperature is 72 degrees. Hardly cool enough for a jacket—or is it?"

She thought I had a tiny thermometer on my watch and wanted to see it. But I had merely timed a tree cricket that was chirping in the near-by shrubbery. I had counted his chirps for 7 seconds, doubled the number, and added 46, which gave me the air temperature.

The crickets are the best known of all insects in respect to their response to temperature and temperature changes. Indeed, one cricket has come to be known as the Temperature Cricket (*Oecanthus niveus*). My interest was attracted to this subject some sixteen years ago when I read a discussion of the work of Dr. Dolbear and Dr. Edes, who had timed crickets against the thermometer. Applying a formula that Dolbear had worked out, I found that the black field cricket (*Gryllus assimilis*) responded well. If you counted the number of chirps it made in 14 seconds and added 40, you had the temperature. With the temperature cricket, you came closer if you added 42, instead of 40, to the number of chirps in 14 seconds. A formula that Dr. Frank

E. Lutz gave for this cricket instructs you to count the chirps for 15 seconds and add 40.

The black field cricket is a rather exasperating thermometer, for he does not often chirp for fourteen seconds without a break. For this cricket, it is better to count the number of chirps for seven seconds and double the number. The temperature cricket, however, otherwise known as the Snowy Tree Cricket, is a steady singer and can be heard nearly every night in summer. He is a common cricket, though many mistake his nocturnal chirping for the music of some tiny species of tree frog.

But the best insect thermometer I have ever found is one that, for want of a precise name, I shall have to call Mr. X. It is certainly a species of cricket, but I have never seen one for certain, for it is secretive and shy. It prefers shrubbery and thick-foliaged vines to trees and remains silent and concealed in the daytime. I have never known one to be more than five or six feet above ground. Its chirp is a single syllable, unlike the two-syllabled call of the snowy tree cricket. Dr. H. F. Strohecker informs me that there are only two species of bush crickets in the region of Roswell, New Mexico—*Cycloptilum comprehensum* Hebard and *Hoplosphyrum boreale*. From my description of its call, he thinks Mr. X is the latter.



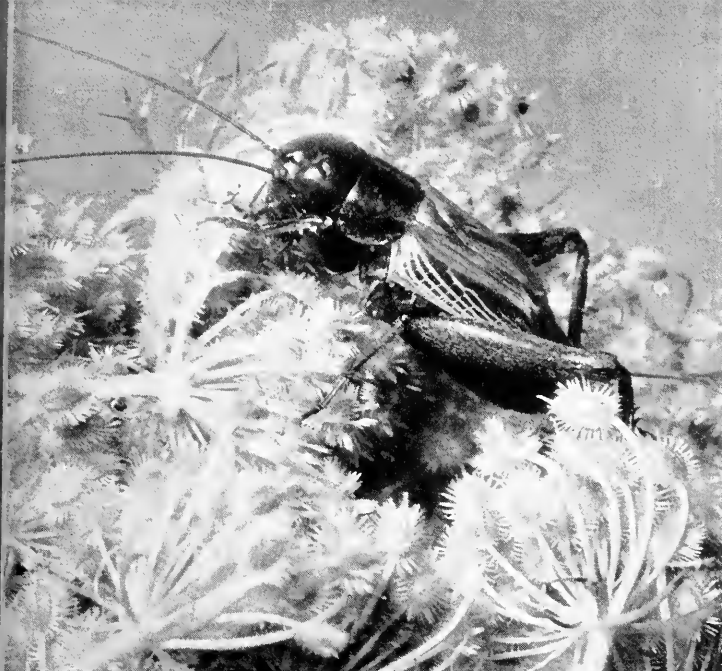


Photo by Edwin Way Teale

▲ **BLACK FIELD CRICKET** (*Gryllus assimilis*). Count the chirps for 14 seconds and add 40. The sum will be the temperature in degrees Fahrenheit

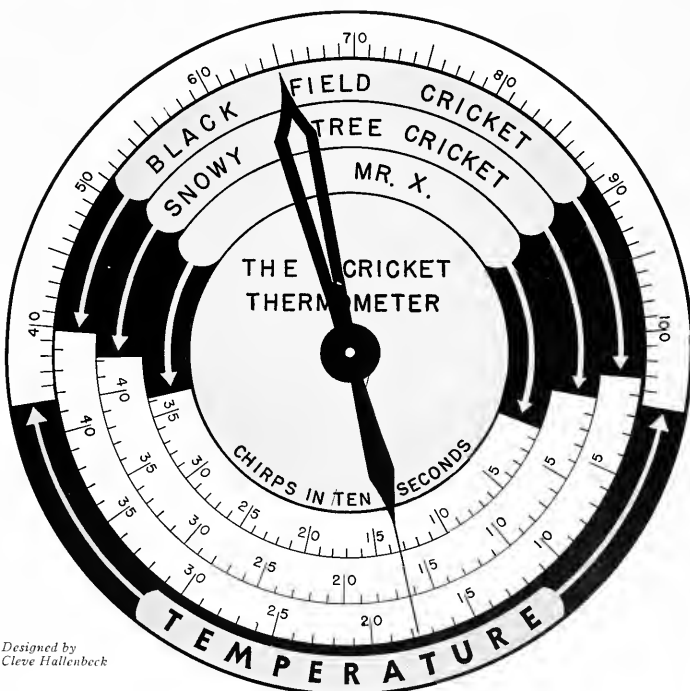
Whenever I sought this cricket with a flashlight at night, it became mute and hid. The Editor of NATURAL HISTORY urged me to capture Mr. X dead or alive, explaining that, while he could not compete with the "wanted" signs we see in post offices, there would be a modest reward. So, equipped with molasses as bait, I fared forth to capture the elusive Mr. X.

I apprehended a culprit I felt sure was the one I had heard singing, and immediately afterwards, his music ceased. I sent it to be identified by an eastern specialist. Alas, he pronounced the specimen immature and therefore incapable of making sound. We shall in time learn the identity of Mr. X, but until some rather puzzling differences of opinion can be resolved, we shall have to call him by that name. Meanwhile, I can assure you, after careful studies with stop watch and thermograph, that Mr. X will tell you the temperature if you count his chirps for 14 seconds and add 46.

This western cricket merits special attention because it lives in the open and so, like the snowy tree

cricket, gives us the free-air temperature. Also, it lasts all summer and chirps through the night—or until the temperature is down to 55 degrees. From about mid-June until frost, its chirp, regular as the ticking of a clock except for a gradual slowing down as the night cools, is heard from dusk to dawn unless the temperature reaches 55 degrees before daylight. In a quiet neighborhood it is audible to a distance of 100 yards. This insect apparently uses the same spot night after night; at least, I frequently have heard what I assumed to be the same ones chirping from the same spots every rainless night throughout the summer. I seldom have heard more than three or four on any one night, and in the daytime I could have pointed out the very spots where, the following night, crickets would take their stands.

I placed a thermograph (a continuously-recording thermometer) within two feet of the nightly posi-



Designed by  
Cleve Hallenbeck

▲ **THE CRICKET THERMOMETER** quickly gives you the temperature for three different crickets. With a straight edge, line up the white dot in the center with the number of chirps in ten seconds. The top scale will then give you the temperature

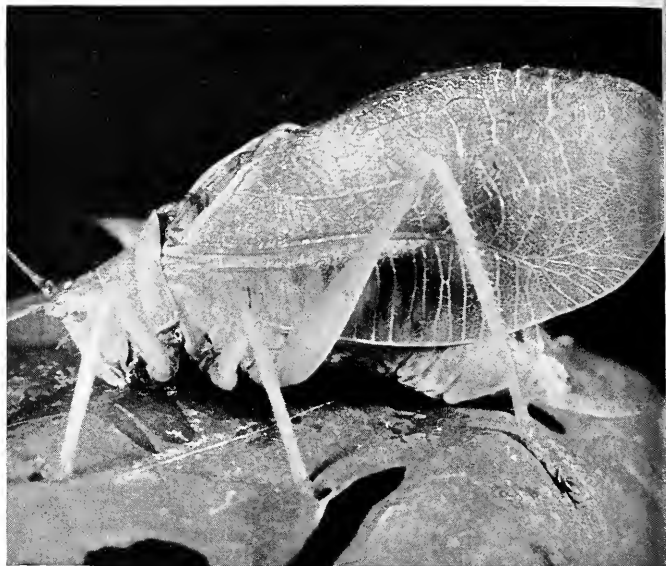
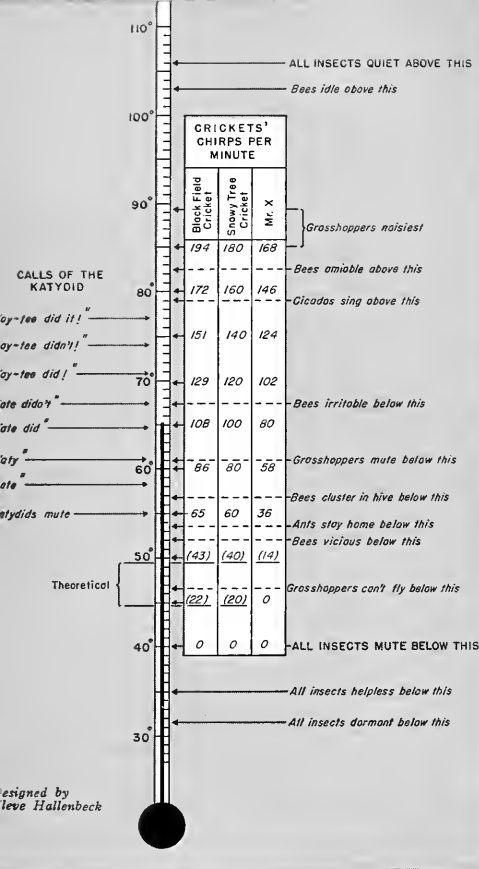


Photo by Lynwood Chace

◀ A SYNOPSIS of the evening's symphony, showing the rigid schedule followed by the various insect musicians, as well as some incidental activities. How fast they run through the score depends, of course, upon how fast the temperature drops

▲ THE KATYDID sings "Katydid-it" when the temperature is 77 degrees or higher. At 74 degrees, he loses the accent on the last syllable and sings "Katy-didn't." And so down, until at 55 degrees he becomes mute

tion of one of these crickets near my open bedroom window and counted and recorded its chirps at intervals during the night without leaving my bed. It was a simple matter later to compare the counts with the temperature record. The experiment was repeated at intervals during the summer. A similar method, I may remark, was used in investigating the responses of other insects to temperature changes.

The katydid (*Pterophylla camellifolia*), a green, tree-dwelling cousin of the crickets, is still another insect thermometer. He is confined to the eastern half of our country, and rural folks in that region are familiar with the nocturnal chorus of this insect in early autumn. As long as they last, katydids are tolerably good thermometers, but with scores of them in a single tree and all of them vociferating about Katy's guilt, it may require a stealthy approach and a selective ear to isolate the song of a single one. Few per-

sons, therefore, have probably observed that the katydid's staccato chirps change with the nightly fall of temperature.

He begins singing at dusk, and if the temperature then is 77 degrees or higher, he starts with "Kay-tee did it!" stressing each syllable. By the time the temperature has fallen to 74 he loses the accent on the final syllable and proclaims that "Kay-tee didn't!" With each additional fall of slightly over three degrees, the call becomes, in succession, "Kay-tee did," "Kate didn't," "Kate did," "Didn't," and "Did." (A sharp-eared acquaintance of mine says the last two calls are "Katy" and "Kate.") In northern districts in September—the month of the katydids—the temperature usually is below 75 degrees at dusk, and so the insect begins with "Kay-tee didn't" or "Kaytee did." Incidentally, Katie can say nothing in her own defense, for female katydids are voiceless.

Of course, we must use our imaginations a bit in transforming the katydid's rasping call into words. We may illustrate it by using K for accented and k for unaccented syllables, thus:

Temperature	Katydid's Call
77 or higher.....	K-K-K-K
74 to 76.....	K-K-K-k
70 to 73.....	K-K-K
67 to 69.....	K-K-k
64 to 66.....	K-K
61 to 63.....	K-k
58 to 60.....	K
55 to 57.....	k
Below 55.....	Katydid mute

The changes in his call do not occur abruptly. The final syllable gradually weakens as the temperature falls, until it ceases or at least becomes inaudible. Then the next syllable similarly weakens and fades out. Also, all the chirps grow weaker and less frequent as the night advances, and the last calls are husky buzzes, apparently pro-

duced with an effort. The temperature may be somewhat different in different trees or in different parts of the same tree, and then one can fancy a dispute going on, some katydids affirming and others denying Katie's guilt. When I was a farm boy in Illinois, I believed that the gradual weakening of the wrangle was due to exhaustion. Since during the katydid season the temperature normally falls to about 45 degrees by morning, the katydids become silent long before daylight; sometimes by midnight.

That ground-dwelling relative of the crickets and katydids, the grasshopper, sings only in the daytime and loves the sunshine. Consequently, he is a difficult subject, for the record of a thermograph or thermometer exposed to the sun is

utterly worthless. In addition, the grasshopper becomes silent or moves away when approached, and his call, unlike the shrill chirps of the cricket or the staccato call of the katydid, is a buzz of varying length. The length and frequency of the buzz appear to be governed by the temperature, but this insect has baffled my attempt at correlation. However, I have found that he cannot jump until the temperature rises to 39 degrees, is unable to fly until it warms up to 47 degrees, and is mute until the temperature rises to 61 or 62 degrees. From that temperature on up to 85 degrees his buzz becomes louder and more frequently repeated.

The three types of insects I have discussed—the cricket, katydid, and grasshopper—all belong to the Orthoptera ("straight-winged" insects) and produce their notes by friction between their outer wings or between these and the thighs of their hind legs. There is another order, the Hymenoptera ("membranous-winged"), including bees, wasps, Diptera, etc., which are voiceless, but they nevertheless show definite reactions to temperature changes.

Some of the reactions of the honeybee have been known to beekeepers ever since the invention of portable thermometers. Bees gather into a compact cluster within the

hive when the temperature falls to 57 degrees and do not "break cluster" as long as the temperature remains below that figure, although they still are able to fly at 40 degrees. As the temperature sinks below 57, the clustered bees begin buzzing to generate heat and thus are able to survive the winter. Honeybees are almost vicious at temperatures in the lower 50's and are still cross in the upper 60's. However, as the air warms up, their disposition improves, and from 85 degrees on up they are almost amiable. (But there are other factors that influence their disposition. They are gentlest when busiest, other factors being equal.) Beekeepers avoid disturbing their bees in cool weather or right after a rain, but on a warm summer day a busy hive can be dismantled and its comb frames scattered about without arousing the wrath of a single bee, provided it is done gently. Bees are inclined to loaf at temperatures above 103 and work best under outdoor temperatures in the 80's, but they maintain 98 to 100 degrees in their hives when building honeycomb, at least at the place where they are building.

The common housefly seeks warmth at temperatures below 55, which means that with the thermometer at or below that figure the fly would rather enter your house

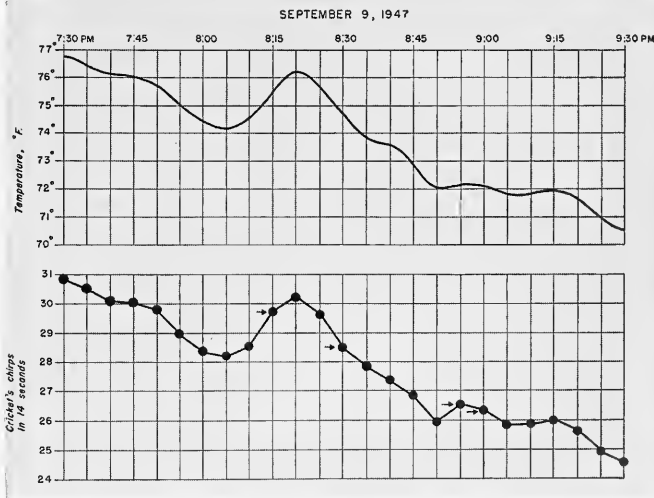
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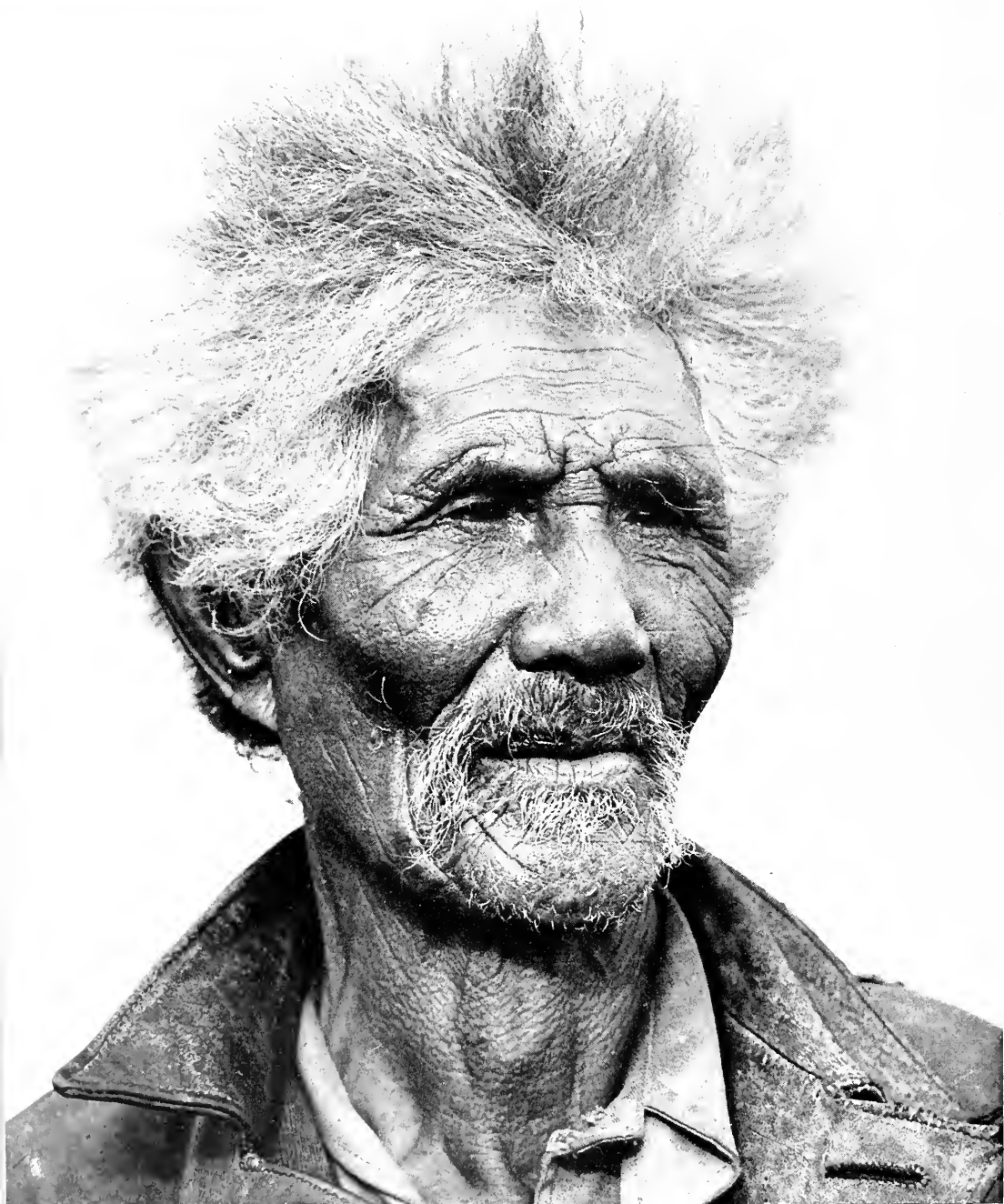


*Photo by Lynwood Chace*

▲ THE GRASSHOPPER sings only in the daytime and is a difficult subject to time against the thermometer. He cannot jump until the thermometer reaches 39 degrees, is unable to fly until it reads 47 degrees, and is mute below 61 or 62 degrees

► TEMPERATURE ACCURACY of cricket. The four arrows show the only places where the insect did not agree with the telethermoscope, and in no case was the difference more than one-quarter degree. It is possible that the instrument did not respond as quickly to a change as the cricket did





▲ HURUMA NUTIRA'S AGE is unknown, but estimated on events he can remember, it would be between 95 and 100. His eyesight is exceptionally good, and he still delights in taking an active part in the catching and preserving of eels during their yearly migration

## *Eeling in New*

An ancient native art is still practiced today  
in the land of the Maoris

By WILLIAM J. GREEN

EVERY year millions of eels migrate to the sea from New Zealand's rivers, and it is then that the Maoris take their harvest of eel food. They set their traps (*hinakis*) in the rivers or use other methods customary in their locality to gather the slippery, squirming mass of eels that help to keep hunger away during the winter months. Somewhat confusing to the outsider is the fact that the word "tuna" means eel in that far southern land.

For centuries the Maoris have been taking tons of eels annually from every stream and lake in the country, but the eel population never appears to lessen. Even today, when the *Pakeha* (Paleface) is fishing the streams every day for eels and dispatching them to Britain and Europe to assist the food supply there, the number of eels does not yet seem to have decreased.

But there are many places in New Zealand where the *Pakeha* may not fish. These are the ancestral fishing grounds of the Maoris. One such spot is at the outlet to the sea from Lake Forsyth in Canterbury, South Island of New Zealand. Here eels have been caught for centuries by several Maori families, the method having been handed down through scores of generations. Today the descendants of those ancient eel-trappers still catch the eels in the old-fashioned way, preparing them for trading as their ancestors did and making a good living from their catch where

ever there are Maoris willing to buy.

Scientists have discovered that the eel is a source of valuable oil, a poultry food, and a fertilizer, as well as one of the richest vitamin-packed foods in the world. From 5000 tons of eels can be extracted oil worth \$100,000, plus 2000 tons of fertilizer worth \$30,000. The oil, which is in demand as a diluent for the fish-oil industry, is very rich in vitamins. The older and bigger the eels, the more vitamin A and D they contain; and the oil content is so great that they require no fat when being fried.

Since his coming to New Zealand from Polynesia, the Maori has learned to value the eel as perhaps

his greatest delicacy. To ensure that the trapping never failed, he studied the eel and learned everything he could about its habits. Always he is ready when the annual migration begins, for the eels are in their best condition when they start their journey. When the vast swarms of eels leave their homes in the lakes and upland waters and head for their breeding grounds in the sea, the traps are in position and the harvest begins.

In North Island rivers, the method of catching eels during their annual migration to the sea is by means of eel weirs (*pa tuna*). These are composed of wooden fences with uprights set closely together to prevent the eels from passing through. The fences are arranged in V-shape, with the open apex downstream, or in two parallel rows slanting across the current. The traps, termed *hinaki*, are usually made of vines, with a funnel entrance, and are set at the lower ends of the weirs.

At Lake Forsyth, in the South

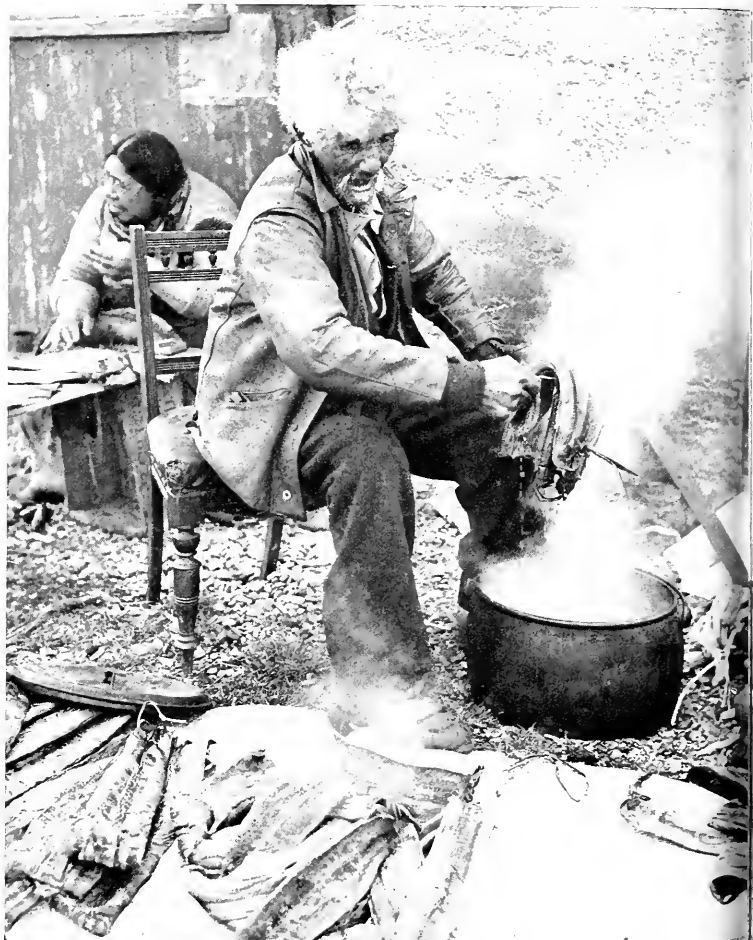


▲ MR. WHARERAU WHAITIRI demonstrates the method of catching eels during migration, while Mr. H. Nutira watches with a knowing eye

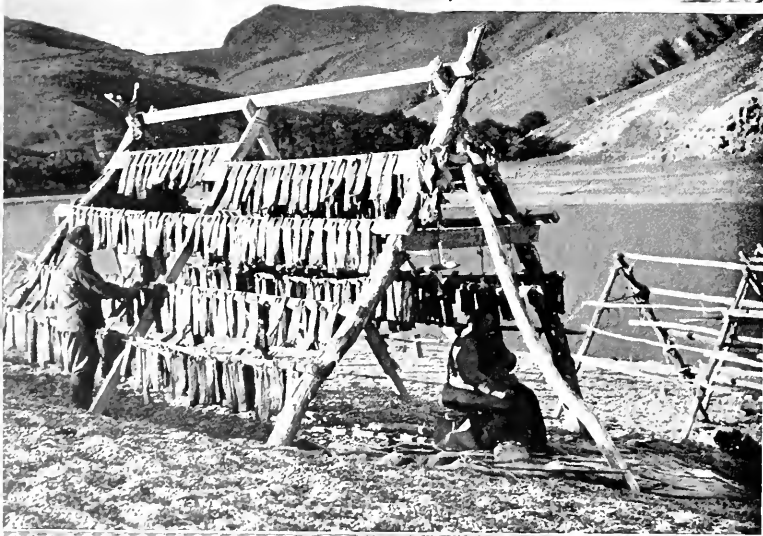
Zealand

Island, a much simpler method is used. The lake is separated from the sea by a shingle bank, and a channel is cut into the shingle at its lowest point, nearest the sea. The channel is approximately fifteen yards long by one yard wide, and into it the eels squirm so quickly and thickly that they are readily pulled out with a modern gaff. The side of the artificial channel has been used for generations, and only the local Maoris who have ancestral rights may use it.

Only the legendary Tuna Tuora remain behind when the eel migration starts. They are the giants—actually permanently sterile females. This explains the individual weights of 40, 70, 80, 96, and even 130 pounds that have been taken in some of the great inland lakes. These giant eels, according to Maori folklore, come barking out of the river at night, looking for lonely men to devour.



▼ A VIEW of the *whata*, or drying structure, laden with eels drying on the banks of Lake Forsyth



▲ AFTER THE FIRST DRYING, the eels are boiled for ten minutes. This renders them more pliable for eating. They are then hung up for a final quick drying before being packed and forwarded to other Maoris in New Zealand. This picture shows Mr. Nutira removing the cooked eels from the pot, while his wife bones them in the background

► WHILE THE MEN attend to the drying of the eels, the women are kept busy making flax baskets, in which the eels will be transported when finally cured



To protect themselves against this menace, the ancients used to light fires and scatter the hot ashes in the belief that Tuna Tuora could not cross such a barrier in search of victims.

Preparation of the eels is a task shared by men and women alike. The eels are split lengthwise, and the intestines and whole backbone are removed. The liver, which has a very high oil content, is always removed and eaten as a special delicacy. At this stage the eels are called "green," and they are hung out on *whatas* to dry. The skin is not removed from the fish, because it too is valued for its food properties. The *whata* is usually built like an inverted "V" and runs north and south to take advantage of the prevailing northeast and northwest

winds. At night the eels are removed indoors. The wind is the drying agent. If the sun is shining, they have to be protected with matting.

Preliminary drying takes four or five weeks. After this the eels are boiled for ten minutes and then returned to the *whatas* for several days of further drying. When this process is completed, they resemble hard strips of leather, but they can then be eaten just as they are, or they can be boiled or braised.

It is in this dry form that they are sold or exchanged for mutton-birds with other Maoris of the far south, or for cod with the natives of the Chatham Islands. Any surplus from the catch during the brief period of migration is carefully stored to ensure supplies during

the winter months, when the trapping is never very good.

Fresh eel tastes rather like trout, and for the white man the favorite method of cooking is stewing. First the flesh is plunged into boiling water for a few minutes to rid it of some of the oil. The fish is then dredged in flour, pepper, and salt and placed in boiling stock into which an onion stuffed with cloves has been added, plus some mace and lemon juice.

After gentle simmering for half an hour, the fish is removed and the gravy is strained and thickened. The fish is returned for thorough heating before serving, and sometimes a little port wine is added. Stewed New Zealand eel is a treat for those with discriminating palates.



# Thundering Waters

A descent into the little-known northwestern section of the Grand Canyon to settle conflicting rumors about a spectacular waterfall

By PHILIP FERRY

Photographs by ALFRED SCHMITZ

IN a decade of desert exploration, we had never aimed at a more elusive objective than Thunder River. Arising in an unknown quadrangle in the northwest corner of Grand Canyon National Park, it was almost as legendary as the golden stream of Pactolus. Several parties were said to have visited the gorge since its discovery in 1904, but no one had apparently been down there for a number of years. Conflicting tales of the thundering waters of this fabulous river had grown up.

Dr. Harold C. Bryant, Superintendent of Grand Canyon National

Park, first proposed the expedition to my friend Al Schmitz and me, after briefing us on the strange story of Thunder River. From time to time over the years, he had received exciting reports of magnificent waterfalls in the canyon, always sighted from a distance by a park ranger, a wandering cattleman, or some local explorer. Some reported mile-long cataracts foaming like Niagara and tumbling down the canyon with a roar like thunder. Even persons who had never seen the river declared that from points on the North Rim they had heard the thunder of its falls

and cataracts. None of these accounts were ever substantiated in full by other narrators; no two agreed on even the broadest aspects. But they concurred on one point: the sight was stupendous.

The most violent disagreements concerned the origin of the river, its size, and the length of its falls. Local tradition had it that the river issued full-born from a tremendous fissure in the canyon wall to go charging down the canyon like a stampede of wild horses, plunging over great drops and rushing along with mad fury. Hade Church, commercial packer and guide, esti-

▼ CANYON OF THE COLORADO RIVER from the North Rim, with Thunder River out of camera range at left





THE TWO LONG DROPS of Thunder Spring Fall

#### ► THE WILD WATER of Thunder River

mated the falls to be 500 feet, while Jonreed Lauritzen, who in 1941 published an account of his visit, denied that any falls existed. Further, he contended that the river had a most uneventful birth, issuing mildly from a spring at the base of a cliff and never, throughout its 8-mile course to the Colorado, exceeding 75 feet in width. This description was so at variance with other reports that Lauritzen could account for the discrepancy only on the ground that the water volume must vary with the seasons. Yet all the conflicting reports suggested that few of the narrators had ever been close enough to the river to estimate its true character with any degree of accuracy.

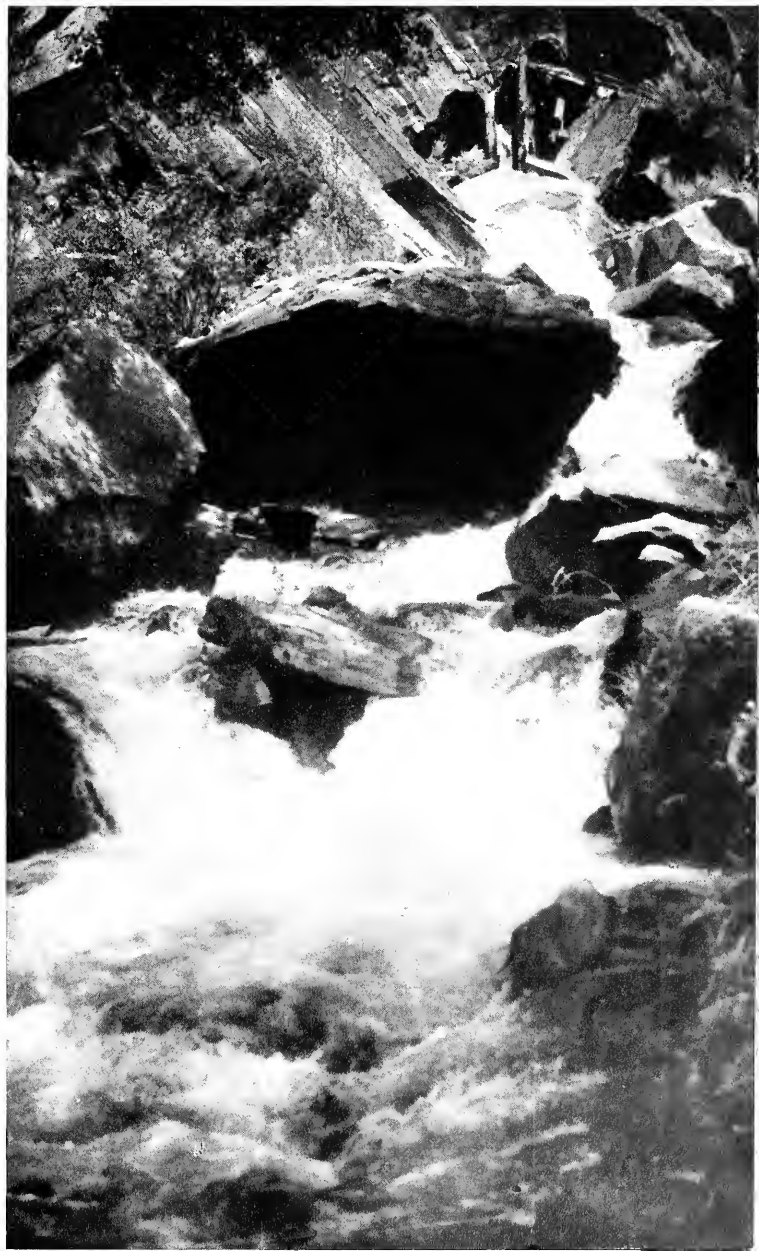
It was months before Schmitz and I decided to hazard such an expedition, but the bewitching fables of Thunder River were irresistibly intriguing, and the difficulties presented by such an undertaking were a challenge not easily dismissed. So we engaged the services of Billy and Tuffy Swapp, local cowpunchers, whose familiar-

ity with Thunder Canyon made them valuable guides. The trip was scheduled for April, in the hope of getting into the canyon when the water was at its fullest, to confirm or disprove the tales about the falls.

Early on an April morning, 1948, we loaded our gear into a jeep, and Tuffy drove us nine miles through a driving snowstorm to the take-off point near Little Saddle, located at the very brink of the chasm.

Here he left us, and Billy took over.

We walked our horses to the edge of the great chasm and looked several thousand feet down into a tortured land of red and buff canyons. Pointing toward the east, beyond a great fin of red sandstone that stood in lone solitude above the canyon floor, Billy said, "Thunder River flows through a smaller canyon that is three levels below this point. I doubt if you can recog-



nize it from this distance. It's twelve or fifteen miles from here."

We studied the depths of the canyon with some misgivings.

"I don't understand," Billy continued, "why anybody wants to go into that gloomy hole! Even the animals dislike the place. We all ways get out as quick as possible."

We looked at Billy apprehensively but mounted our horses, and he led us down a precipitous trail that fell away into the canyons.

There were five of us poised for the attempt on Thunder Canyon. The gear each carried included sleeping bag, poncho, camera, extra shoes, personal items, and emergency equipment. We had climbing ropes to help us up and down the canyon walls. And since we hoped to put on record for the first time all the pertinent data on Thunder River and its canyon, we were equipped to compute the height of the canyon walls, the width of the river, and the velocity of the water. We even had a thermometer to take the water's temperature!

Without a guide it would have been virtually impossible for us to locate the beginning of the trail. Once Billy pointed it out, it was plain enough, but we could see that down on the flat it petered out completely and Billy would have to rely entirely on his knowledge of the country.

Taking off from Little Saddle,

the trail dropped abruptly in a series of switchbacks that plunged down the face of the cliff through the familiar Kaibab and Coconino formations. However much it wandered about, it always managed to return to a steady course eastward. Nearing the interesting geological formation called the Fishtail, it leveled off on a bench of the Supai formation. Continuing eastward, we made our way over the henna-colored sandstone for six or seven miles. Billy was careful to point out the occasional pools of water trapped in sinkholes in the sandstone, knowing how necessary the water would be to the animals on the uptrail back—knowing, too, how vital it would be to anyone who might become separated from the party.

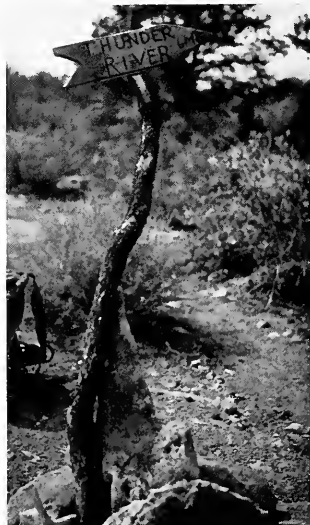
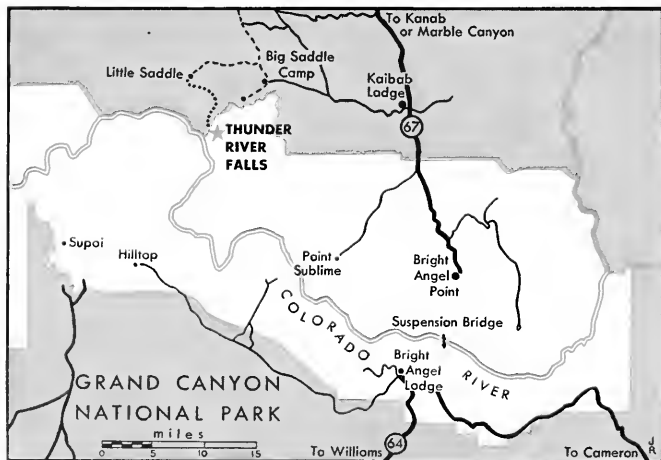
At one confusing spot, it was necessary to make an abrupt right-angle turn to skirt a chasm that blocked our path. Billy dismounted and whittled out a wooden arrow, then scratched in the words "Thunder River, 6 mi." and set it upright in a cairn of boulders. For the first time the trail to Thunder River had a trail-marker.

Threading in and out of a maze of canyons that would have baffled a mountain sheep, we eventually found ourselves at the top of the Red Wall, an infallible geological signpost in the Grand Canyon country. The trail down the wall was

so steep that we dismounted and made the descent on foot, taking care to avoid the hooves of the skidding animals.

Dropping down to the second of our three benches, we found ourselves at the head of Surprise Valley, a saucer-shaped depression with olive-hued desert vegetation. Continuing eastward, we made our way across the valley and up the farther slope of the saucer. Reaching the rock-rimmed lip, we peered over into a wild canyon that opened at our feet, and got our first glimpse of Thunder Spring and Falls. A final drop of 1000 feet and we stood at last in full view of our objective.

This route approached the spring from the topside and paralleled the creek for its entire length. The trail ran so close to the creek that at times the water actually flooded the trail. This approach gave us a full-faced close-up of Thunder Spring from the time it issued from the canyon wall to its confluence with Tapeats Creek, a few hundred feet away. We set up camp at the foot of the tumbling creek, and its rush-



▲ THE PARTY erected a trail marker, the first to show the way toward Thunder River

► CAMP near Tapeats Creek, whose rushing waters lulled the party to sleep each night

ing waters lulled us to sleep each night.

Looking at the magnificent spectacle, we had to admit that the men who told the tallest tales had been most nearly correct in their descriptions. Thunder Spring does indeed issue from the canyon wall, and it does (at least at the season when we saw it) form a magnificent waterfall in its long drop to the canyon floor. The fall is remarkable in that it is not formed by a stream tumbling over the canyon rim. It originates in a subterranean source and pours directly out of the cliff wall, about midway between canyon bottom and rim top.

At the time of our visit, the water issued in twin streams from two vertical slits in the cliff wall, perhaps 1000 feet above the canyon floor. The two streams fell 50 feet in a V-shaped pattern and then merged to form the first waterfall. From this point, the fall has a form similar to that of Yosemite Falls, in California, for it drops 100 feet in a straight fall, then glissades a few yards over a rocky shelf, to drop away again for 150 feet. Finally it glides down the canyon in a long cascade that runs a short distance to a juncture with Tapeats Creek.

While Hade Church's stupendous yarn about a 500-foot waterfall would seem a considerable exaggeration, his estimate was a matter of individual interpretation. Taking the fall from the point where it issues from the canyon wall to the spot where it levels off



▲ TAPEATS CANYON, with Tapeats Creek in foreground

into a rushing cascade, the over-all drop could be close to 400 feet. As explained, however, the plunge is broken into three distinct drops. Viewed from the rim top, where most of the witnesses stood, the

moving white sheet would undoubtedly tend to flatten out into an unbroken plane and thus create the illusion of an uninterrupted plunge.

At its widest point, just at the first drop, the fall is perhaps 100 feet wide. Its plunge is not a smooth one but is interrupted by a rocky background that causes it to ripple gracefully down the cliff face. The full career of the stream—Thunder Creek, as it is called at this point—is not more than 1000 feet. Tumbling and roaring down the narrow canyon, it runs at a right angle toward Tapeats Creek. At its juncture with the creek, it separates like the tines of a trident and enters the larger stream in three distinct arms. All in all, it is a magnificent spectacle.

Thunder River is well named, although no one knows who named





it. In 1869, Major Powell, the original explorer of the Colorado River, saw only the confluence of the lower river with the Colorado and named it Tapeats Creek after a Paiute Indian in his employ. On some maps it is so identified; others call *this* stream Thunder River, much to the confusion of map makers and explorers. With a roar it rushes along at a rate we estimated to be 20 miles per hour, a speed normally reached only by floodwater racing down a narrow gorge. Always it is a charging demon rushing headlong to a union with the Colorado.

The bursting of water out of the cliff walls appears to be a characteristic feature of the region. At frequent intervals throughout the canyons, openings in the sheer walls give evidence that water may have issued from them at some time in the recent past. Indeed, flanking Thunder Spring itself are several cracks in the cliff walls from which water gushes in graceful falls that are miniatures of the main fall. It may be that a large subterranean stream flows through the district, breaking through the cliff walls at various points, changing its course over the years, and forming the frequent minor chasms that characterize the region.

Thunder Creek may not be unique, therefore, in issuing from a vertical wall, but its impressive birth 1000 feet above the canyon floor, its width and plunge, and its short, explosive run to a junction with Tapeats Creek are impressive beyond words.

On our last day in the canyon, Thunder River gave us a near-tragic demonstration of its velocity and ferocity. On our way out of the canyon, as Schmitz was delicately guiding his horse through the foaming rapids formed by the joining of Thunder River and Tapeats Creek, the nervous animal lost its footing and plunged sideways into the stream, landing full on the rider. Bobbing to the surface, Schmitz managed to shake loose from the stirrups. With his heavy photographic equipment strapped to his back, he was caught up by the racing rapids and projected

downstream, head foremost and backward, helpless to save himself and unable to see where he was heading. He hurtled along too fast for us on shore to aid him and finally was brought up against the bank 100 feet downstream, where he managed to struggle ashore. His back was painfully bruised, and some of his valuable photographic equipment was lost.

Every Kodachrome he had taken in Thunder Canyon was ruined. After two years of planning and preparation, culminating in days of photographing, the film that was to be a major reward of his visit to Thunder River had suddenly become a water-soaked loss. Although the other photographers in the party had been busy taking pictures, Schmitz, who had been most instrumental in projecting the expedition, emerged without a single color picture of his own.

With the aid and counsel of Billy the packer, who has run cattle into the region since boyhood, we were able to solve much of the mystery surrounding Thunder River. The confusion is caused by a duplication of names and by the fact that not one but two streams are involved. When Lauritzen speaks of Thunder River as issuing "mildly from the ground," he is correct in describing one stream. When Hade Church and Ranger R. E. Laws, of the National Park Service, contradict him by declaring that Thunder Creek pours spectacularly out of the cliffside, they, too, are correct. However, the two factions are describing different streams. That R. E. Laws was referring to Thunder River and not Tapeats Creek became dramatically evident when we found his signature scratched into a large sandstone boulder at the head of the steep trail leading down to the stream. The date accompanying the name was Feb. 15, 1924.

Further confusion is added by the fact that Tapeats Creek rises in what local cattlemen call Bridger Canyon—and there are two Bridger Canyons! Tapeats Creek is designated by the U. S. Geographic Board as the main stream, which arises on the North Rim of the

Grand Canyon and flows southwest to the Colorado. Thunder Creek or River drains southeastward into Tapeats Creek.

While we had planned to explore upstream in Tapeats Creek the great volume of water, together with the rocky nature of the stream bottom, rendered such a venture too precarious to undertake. While Tapeats Creek is not deep (except in spots where there are pools 20 feet deep), it is exceedingly swift. We were able to ford it only by horse and then at carefully selected spots. Billy assured us that during previous visits he had found the water at the ford only knee-high; this time it reached his hips. Generally the water is crystal-clear, but at this time of high water it was muddy and opaque.

While travel upstream was not practicable, there were no appreciable obstacles to our progress downstream to the Colorado River, and we made the round trip several times during our stay. This is rugged country. The canyons are narrow and rough and give evidence of having seen convulsive action in the past. Tumbling cliffs, prodigious boulders, and sinking terraces all combine to make the narrow gorge a jumble of twisted terrain. However, to an experienced walker progress is not difficult. We walked down Tapeats Creek to the Colorado without drawing a deep breath, making the trip in an hour and a half. While we did not succeed in getting down to the Colorado itself because of the unusually high water, we were within plain sight of it and can state that reaching the river is not an impossibility in September or October, when the water is low and the stream navigable on foot.

Tapeats Creek follows a snaky course, and its sloping bottom keeps it tumbling along at a rapid rate. We can say positively that, contrary to frequent reports, there are no waterfalls in this part of the main stream, though there are reports of one farther upstream. There are many short rapids that drop two to four feet, but these can hardly be called falls. Nearing its junc-





▲ LOOKING out of Tapeats Canyon toward the Grand Canyon and the South Rim beyond. Tiny Tapeats Creek in foreground is actually more than 30 feet wide

ture with the Colorado, the incline increases rapidly, and the stream hurdles over a rough course of low terraces and boiling rapids. Throughout the major part of its rampaging course, it is a boulder-strewn cauldron.

While the creek is generally reported to be 75 feet wide, we found from actual measurements that it falls far short of this figure. We measured the stream at the widest spot we could find, where Thunder River joins it, and it measured a modest 38 feet. From various other measurements, we estimated that its average width from beginning to end probably does not exceed 25 feet. However, it discharges a tremendous volume of water, and no doubt the spectacle of this racing torrent has exaggerated the size of the stream to persons sighting it from the high rim. The conclusion could easily be reached that the foaming cataract is of floodlike proportions.

While the facts about the river, its springs, and its falls have been highly romanticized, the exciting tales concerning the fishing are genuine enough. The stream abounds

in finned whoppers whose size and avidity are fabulous. Looking at such fishes, we could appreciate why the packer-guides are able to command outrageous prices for packing fishermen into the canyon. The only bait required—the fierce-looking little insect called hellgram-mite—is found in the stream itself, under the rocks.

The region has been a happy hunting ground for locals, who have had the fishing to themselves for years. Even so, only a few dozen persons have visited Thunder Canyon in the years since its discovery in 1904. A crude register in the canyon shows a total of only 50-odd names—all local residents. No entries appear between 1940 and 1947.

The scarcity of visitors over the years has permitted the trout,

*Continued on page 284*

▼ TAPEATS CREEK steepens its incline sharply as it approaches the mighty Colorado. Throughout much of its course, its boulder-strewn channel is turbulent and angry. But at low water, the route would be passable right down to the Colorado



EVEN to those who know them not, the oceans are restless, and in the affairs of men there is a tide to be taken at the flood. The ebb and flow of the seas, pulsing in rhythm with the sun and the moon as they pull together or in opposition, has entered the mind and literature of mankind. For centuries the glamor of distant lands and the thought of wind-filled sails have caused boys to run away to sea.

As the wind blows, so the water moves. The ocean currents are set in motion not only at the surface but in layer after layer, until even in the cold and dark abyss, the waters flow slowly but steadily over the deep-sea ooze. The whole enormous mass of the ocean is in everlasting movement, swept by the high winds above, deflected by continental shores, warmed by the equatorial sun, and cooled by polar ice, but above all, spun by the spinning earth.

# The Spin OF THE SEA

Symbolic of restlessness throughout the ages, the oceans circulate relentlessly on their ordered paths, shaping the course of history and affecting the destiny of nations

By N. J. BERRILL

*McGill University*

Each of the seven seas spins slowly about itself like a great Catherine wheel, each in its own way, with streamers swinging away from the rim. The winds help set the water in motion, and the earth's

rotation turns the direction of flow to the right in the Northern Hemisphere, to the left in the Southern.

For the western world the North Atlantic has become the best known ocean, and each of the various currents that make up the great ocean wheel has played its part in the destiny of nations.

The southern half of the wheel is formed by the Canaries Drift, southwest from the Straits of Gibraltar. Farther along, it swings west to northwest toward the Caribbean and Antilles and becomes known as the North Equatorial Current. This was the course that Columbus sailed and also those that followed him for the gold of the Spanish Main. On their way they saw tropic birds, tuna fish, and dorado, or dolphin fish. Columbus, in his diary, also noted seaweed, and crabs with the weed, far from land. He was, in fact, sailing with the wind and current along the southern edge of the wheel, and the weed that he saw came from the great eddy that forms its center, known the world over as the Sargasso Sea.

The Sargasso Sea was probably known in legend long before Co-

◀ MANY taste the violence of the sea where breakers beat upon rocky shores. But more momentous in the affairs of man are the ponderous currents that stir it tirelessly throughout its farthest reaches

*Philip Gendreau photo*



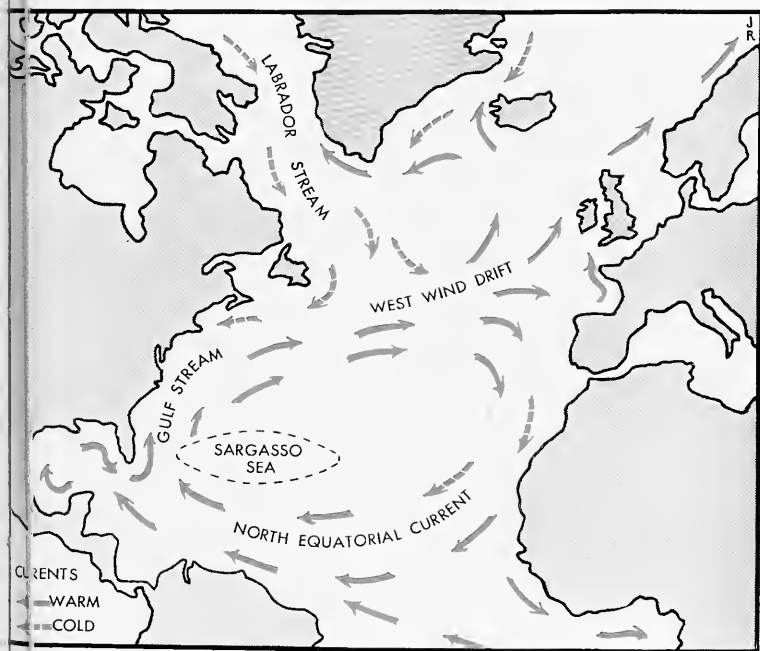
lumbus, even to the Phoenicians. It is a dark translucent blue, highly saline, with innumerable patches of yellow-green floating seaweed, sometimes matted together acres across but more generally scattered. It is an area of slowly turning or still water where sargassum, or gulfweed, accumulates. The weed propagates by the vigorous growth of its yellow fronds, breaking up into parts as its weight increases or waves disturb it. Old growth sinks, new sprigs with their bladders rise buoyantly to the surface. While the sargassum weed is probably descended from a rock-fast form similar to one now found in the region of the Gulf of Mexico, the great masses in the Sargasso Sea are self-sustaining, growing vegetatively and vigorously, forming no spores and in other ways exhibiting a complete adaptation to a floating, drifting existence far remote from shore and shallow water.

Whatever its source and however well the Sargasso Sea maintains itself, it is something more than an enormous eddy 1000 miles from any land, and it is of immense age. The weed shelters a host of small sea animals—specially adapted crabs and other crustaceans, angler fish camouflaged like the weed, sargassum anemones, worms, and a host of others, all symbolic of the semipermanence of their peculiar world. The sargassum fish, or angler, not only resembles the weed but can quickly change its patterns and shades as it changes its environment. Like other fishes of the same group, it has a "fishing rod" with "bait" extending from its forehead and a tremendous gape to its jaws, so that it can take in fish almost as large as itself.

The Sargasso's northern rim of flowing wind and water is far more strident than the tropical siren of the south. Driving north from the

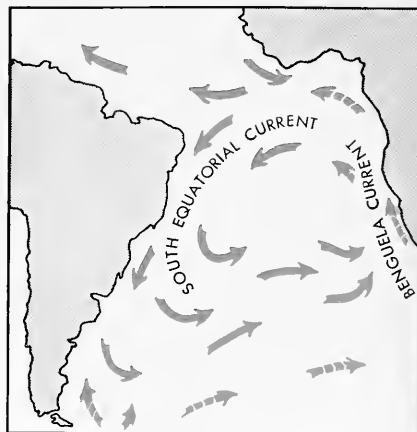
Caribbean and Gulf of Mexico, the Gulf Stream pours out through the narrow straits of Florida. Then it flows to the northeast along the course of the continental shelf and finally swings across the whole span of the Atlantic as the West Wind Drift. This completes the circle and brings the water from the warm cauldron of the West Indies and the equatorial Atlantic to the shores of western and northern Europe.

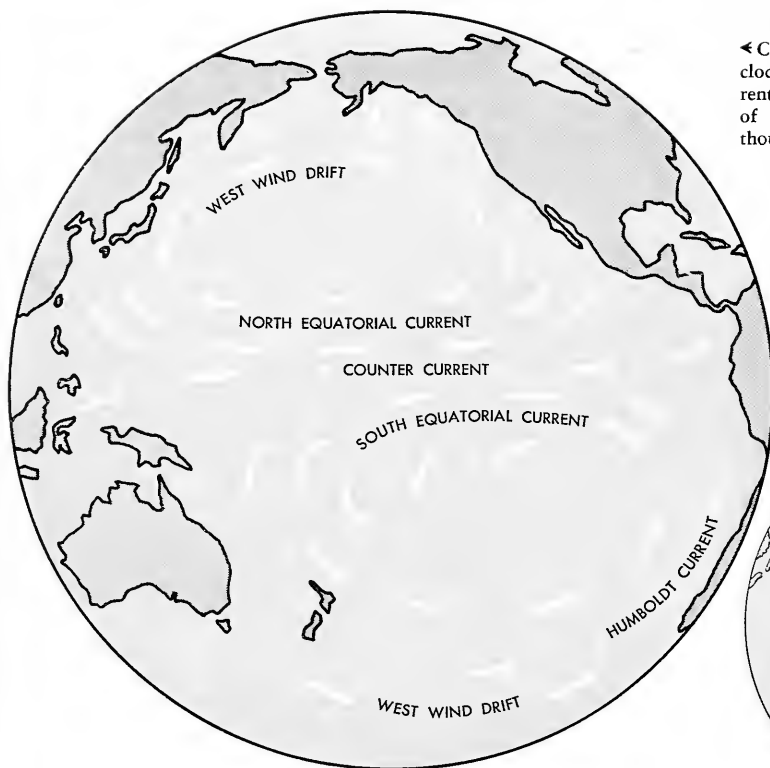
The stream driving between Cuba and the Florida Keys is equal to about one thousand Mississippi where the river enters the sea. Beyond the straits, the stream is reinforced by the Antilles Current, swinging up from the southern and western rim of the Sargasso Eddy. This, however, is not the only contribution of the Sargasso Sea to the Gulf Stream. The great Sargasso Eddy, circulating clockwise, rolls from the outer margin in toward the center, then down into the depths and out toward the margin again at a lower level. A vortex is created like that of a whirlpool, though on a gigantic scale, concentrating the sargassum weed toward the center and carrying warm water down into the depths. This water warms the colder layer beneath and draws it out toward the northern edge of the Sargasso Sea. This low-level current, flowing out from the vortex, discharges more than twenty million tons of water into the Gulf Stream each second.



MOST FAMILIAR of the great circular currents that flow in all the oceans is the Gulf Stream. Part of it flows past England and Norway, but part turns southward to meet the North Equatorial current and thus complete the circle

➤ SOUTH of the equator the currents flow counterclockwise. The South Equatorial Current turns southward past Brazil to the latitude of Uruguay and Argentina and then flows eastward to join the Benguela Current





◀ CLOCKWISE in the north, counter-clockwise in the south, the chief currents of the Pacific resemble those of the North and South Atlantic, though on a larger scale

▼ AROUND the Antarctic Continent, the sea moves continually eastward, in what is known as the Antarctic West Wind Drift



What is produced must be consumed, and the great flow of the warm Gulf Stream eventually reaches high latitudes in the region of Spitzbergen. There it becomes cool and slowly rotates about another sinking center, falling to the sea floor and moving back toward the equator through the oceanic abyss. Tropical heat and polar cooling thus add a vertical wheel system to the spinning spirals of the surface.

Except for this system, western civilization would have remained an essentially Mediterranean society, for it is the Gulf Stream and its offshoot, the North Atlantic Drift, that have brought a temperate climate as far north as the Arctic Circle in Norway. To recognize this, it is only necessary to realize that on the two sides of the Atlantic, Labrador and Denmark lie at the same latitude.

Thus the temperate Gulf water, entering the North Sea and the Norwegian Sea, made the bordering

lands attractive to man. At the same time, however, the prevailing opposition of the wind and currents discouraged all but the most hardy from attempting to sail west. In fact, most of the expeditions were of short range, to Britain, the Faröes, and Iceland; thence to Greenland and the Vinland of Eric the Red. It was only this last venture that may have had the assistance and not the opposition of nature, for the Greenland Current and Labrador Stream flow south to the American side of the North Atlantic.

These are cold, polar currents streaming south to replace warmer water dragged across the Atlantic along the rim of the Gulf Stream, and they bring semiarctic conditions to the bordering lands, at least in winter. But they also create one of the greatest sea fisheries in the world. The Grand Banks of Newfoundland are part of the submarine plain, or continental shelf, bordering North America in this

region. It is here that the cold southward-flowing Labrador Stream meets the warm subtropical waters of the Gulf Stream as it flows to the northeast. As a result of the convergence, the rich surface water from the north sinks to the sea floor and establishes ideal conditions for the fisheries. In this region where the warm and cold waters come together, a cold wall of water effectively forms a barrier to many southern forms of life. At one time a U. S. Coast Guard Cutter lying across the cold wall found the sea temperature at the bow to be 34 degrees and at the stem 56 degrees F.

Such a sinking of cold waters brings to the fore the three-dimensional character of the ocean currents. The surface spinning of the North Equatorial Current and the Gulf Stream, with the Sargasso Sea as its eddy, has its counterpart in a slow up-and-down rotation of waters. The cold, heavy water from

the north sinks to progressively greater depth as it moves south beneath the Gulf Stream and flows slowly across the floor of the ocean toward the equator. In the tropical zone, surface water is continuously being warmed and evaporated, so that water continuously rises from below to replace it, drawn eventually from polar sources.

Accordingly, surface water and deep water in the same area may have little in common and may differ in direction and rate of flow, in temperature and salinity, and in qualities dependent upon the penetration of light. In a way partly understood, part mystery, the eels of two continents have exploited the North Atlantic System. The mature eels of both America and Europe enter the sea and by some means find their way through cold dark waters, across thousands of miles, to breed in deep water below the western part of the Sargasso Sea and probably to die. How eels, or any other fish for that matter, can sense even the existence of currents over the oceanic abyss is obscure, unless they can follow the demarcation line between two adjacent streams of salt water, differing perhaps a little in temperature or salinity.

The sweeping of the young eels by the Gulf Stream, on the one hand toward the American coastline and on the other across the Atlantic to the European coasts, is a tale well known and often told, but occasionally stranger things get caught up in the same maelstrom to make outlandish voyages. During the hurricane of 1900, the coffin of the actor Charles Coghland is said to have been swept out to sea from Galveston, Texas, apparently to drift in the circulating waters of the Gulf of Mexico until it was drawn into the outpouring Gulf Stream between Cuba and Florida. Thence it floated northeast until by some chance it was blown from its transatlantic course into the mouth of the Gulf of St. Lawrence, to come ashore near the actor's old home at Prince Edward Island, a journey of some two thousand miles!

In more recent years, a mysterious microscopic menace of the sea moved up the Atlantic seaboard from southern waters and later crossed to Europe. First appearing in 1930, it attacked the eel grass in innumerable bays and estuaries in Florida, and in 1931 it swept northward in a destructive wave. By 1932, the eel beds had vanished from the coast from Cape Hatteras to Nova Scotia. It crossed the Atlantic with the West Wind Drift, traveling at much the same pace as the larval eels, and first affected the western end of the English Channel toward the end of 1931. Late in 1932, the first marked effects were evident. When it invaded the sheltered waters of northern Europe, the eel grass died, the supporting banks broke up, and a rich, shallow-water fauna disintegrated. Even migratory geese and other birds suffered as they flew south from summers in the arctic, descending in vain along the coast to feed off the stricken beds.

Water movements have been investigated to a great extent by the method of casting sealed bottles adrift in the sea, containing information as to the place and time of liberation. Recently one such drift bottle, set free at Sidney, Nova Scotia, arrived at the coast of South Australia after possibly the longest bottle voyage known. To have accomplished this, the bottle must have drifted northward and eastward across the Atlantic with the Gulf Stream, then south with the Canaries Stream to the Equatorial Current. Possibly some storm blew it from the North Equatorial into the South Equatorial Current, so that it entered the Brazil Current instead of ending up in the region of the Sargasso Sea. The Brazil Current carried it down the east coast of South America toward Cape Horn. Here it must have been caught up in the sweep of the Antarctic West Wind Drift, to be carried east across the South Atlantic and Indian Ocean and finally to reach the shores of Australia.

Each of the oceans has a system of currents like that of the North Atlantic, and the similarity is so

clear that there is plainly a general scheme. The origin of the movement is from the great equatorial streams that flow from east to west. The motive force comes from the continual action of the Northeast and Southeast Trade Winds, which drive the surface water of the equatorial belt continuously to the west. The force exerted by the earth's rotation on bodies free to move on its surface is further seen in the deflection of these broad currents north and south of the equator. In the north the deflection is to the right or clockwise; in the south it is to the left or counterclockwise.

The North and South Atlantic show this clearly. In the north, the North Equatorial Current (the part of the Equatorial Stream lying to the north of the equator) flows west and spins to the north as the Gulf Stream. The part lying south of the equator, the South Equatorial Current, also flows west, but it turns to the south at the coast of Brazil, and its warm waters extend their benevolence far down the eastern coast of South America.

In the Pacific there are no land masses to confuse the picture, and the great spinning movements of the North and South Pacific are well developed. In the North Pacific the circulation resembles that of the North Atlantic. The North Equatorial Current flows west across the waist of the Pacific to the Philippines, thence northward as the "Black Current" of Japan, and eastward to North America. The circle is completed by the cool California Current flowing southeast to join the eastern end of the Equatorial Stream. Kamchatka, incidentally, is kept cold by a replacement current comparable to the Labrador Stream.

In the South Pacific, the reverse system is seen again, and in some ways this system is of greater interest. Matching the Cold Benguela Current of the South Atlantic, the Humboldt Current swings north along the west coast of South America, carrying water of subantarctic origin almost as far north as the equator. Near the equator it

turns west as the South Equatorial Current, and the circle sweeps past the Galápagos in a grand arc through the Polynesian Islands.

The cool waters of the Humboldt Current hold more oxygen and carbon dioxide than most other waters of similar latitudes, and they also receive much organic matter from the outpouring of the coastal rivers. From these and other causes, the current is abundantly rich in microscopic vegetation and in innumerable small marine animals that depend upon it. This dense community in turn supports an almost infinite population of fishes, among them the abundant little herring-like anchovetas. While the coastal fisheries of Peru and Chile are important, sea birds are the chief direct benefactors, especially the guanay (a cormorant) and pelican. The guanay feeds mainly upon the anchovetas and other small fish and crustaceans.

These multitudes of birds breed and rest on the coastal islands and have done so for so long that their excrement, or guano, has accumulated in enormous masses and has become world famous as a source of nitrate for fertilizer. Much of the prosperity of Peru depends upon this resource and therefore on the continued protection of the birds.

The guanays are of antarctic origin and have probably nested for more than 100,000 years on the coast and islands of Peru. Only the cold temperature of the Humboldt Current makes it possible for them to exist so far north.

Occasionally, at irregular intervals, a warm tropical current intrudes between the Peruvian coast and the cold water, with disastrous effects. The rise in temperature in the coastal waters kills the fishes and smaller organisms, producing such decomposition and liberation of hydrogen sulphide as to blacken the paint of ships. When this happens, the guanays suffer accordingly, and a few years ago millions lost their lives from malnutrition.

The penguin is another antarctic sea bird that has exploited the presence of the Humboldt Current, thriving on its abundant fish and

tolerating tropical latitudes only because of the cool water. There are, in fact, two penguins that have migrated into the tropical latitudes, the Peruvian penguin and the even more adventurous Galápagos penguin, which is actually in the equatorial zone.

Currents of diverse origin usually do not mix, and William Beebe, on his Arcturus Expedition to explore the Humboldt Current, actually saw the line of water separating two westward-flowing streams of warm water some 200 miles southeast of the Cocos Islands, close to the northern edge of the Humboldt. Flowing at somewhat different rates and with several degrees difference in temperature, the junction created a rip of foaming water against which all the floating jetsam for miles was held, including logs of wood covered with barnacles and sheltering crabs and small shore-loving fish. The rip was followed for 100 miles or so and was the focus of all kinds of animal life. As many as 38 species of trees, plants, and seeds were found. The steady flow to the westward at about two miles an hour would eventually carry the survivors of many shore and even land forms across vast spaces of the ocean, perhaps to colonize islands in their path.

The westward sweep of the currents from the coast of Peru has given rise to much speculation as to whether the islands of the Pacific were colonized by natives from Asia or South America. The recent voyage of the raft "Kon-Tiki," drifting 4000 miles with the South Equatorial Current from Peru to the Low Archipelago, shows at least the possibility of the western passage.\*

There is one remaining spinning system that stands apart. This is in the antarctic. Here the waters flow in the same direction as the earth rotates on its axis, truly reflecting the spin of the earth. In other words, while the earth is constantly turning toward the rising sun, the waters of the Antarctic are turning even faster in the same direction, as

\* See "Voyage of the Raft 'Kon-Tiki,'" by Thor Heyerdahl, *NATURAL HISTORY*, June, 1948.

# Fish Fly

Fluttering about on lacy wings, it shows little resemblance to the spiny, underwater pirate from which it developed

By EDWIN WAY TEALE

Photograph by the author

LIKE the mayfly and the great silk moths (*Polyphemus*, *Cecropia*, and *Luna*), the fish fly, *Chauliodes pectinicornis*, lives but a short time and probably does not eat at all. It emerges late in spring. The insect shown here was photographed in mid-June. On lacy wings that are gray-brown and spotted with white and have a spread of as much as three and a half inches, the fish fly flutters about



◀ THE LARVA of the fish fly is a horrendous creature quite unlike the winged adult it will become

though to hurry on ahead. The flow of water is due to a number of factors, but one of the most powerful is that the ocean in the temperate and tropical latitudes is warmer and lighter, and the ocean surface there is actually higher than the cold water to the south. Consequently it flows down a gentle slope toward the antarctic, where the earth's spin swings it toward the east. It is also aided in the same direction by strong westerly winds forever blowing from west to east between latitudes 40 degrees and 60 degrees S., blowing from the right toward the warm

NATURAL HISTORY, JUNE, 1949



during the hours of darkness. Females deposit masses of from 1000 to 2000 oval, reddish-brown eggs on branches and leaves and stones that overhang the water.

From these eggs hatch larvae that resemble minute spiny worms. They drop into the water to live for many months as predaceous, aquatic creatures. Lurking under stones or clinging to submerged logs, they obtain oxygen from the water through gills and grow until they reach a length of an inch and a half. They are closely related to that favorite food of the bass, the larva of the Dobson fly, variously known as the hellgrammite, the flip-flap, the alligator, the water grampus, and the conniption bug. But, unlike the hellgrammite, which lives under stones only in rapids and riffles and swift-running streams, the young fish fly is often found in sluggish water.

At the end of its aquatic life, it creeps up the bank to pupate under a log or stone or in the earth. The cinnamon-brown adult emerges with long antennae "feathered" on only one side. This feature gives the insect its colloquial name—"The Comb-Horned Fish Fly." Rather secretive, it clings quietly to vegetation throughout the day. Because of this habit, it is observed but rarely, in spite of its large size, striking appearance, and wide distribution east of the Rockies.



▲ THE FISH FLY (*Chauliodes pectinicornis*) lives in its adult form only a short time and probably never eats

rising sun. Thus it is called the Antarctic West Wind Drift.

The Antarctic Drift flows steadily around the Antarctic Continent without let or hindrance, little known and little traveled except for whaling ships and an occasional antarctic expedition. The giant whales have vanished from the northern hemisphere, only their smaller cousins surviving, and now in the West Wind Drift of the antarctic alone do the "great whales go sailing by, round the world for ever and aye." Apart from the effect of the slaughter by floating whale factories, the whales abound in

these waters because their food is abundant. The largest whales feed mainly on relatively minute shrimp-like forms that thrive in the cold nutrient waters of the far south. Where these organisms are, the whales are likely to be.

Even in the Drift, however, there are currents within currents, and these are utilized by the whale shrimps to limit their own particular drift. Just as an expert balloonist can guide his direction of travel by controlling his altitude, so the shrimps and other small forms keep within the bounds of the Antarctic Drift. They are swept slowly to the

north from the region of the Antarctic Continent, and as they approach the warmer water they sink from the surface layers into deeper water. There they drift with the countercurrent moving in the opposite direction, south to the Antarctic Continent. In this manner they tend to circulate slowly to the north and south, though all the time being swept to the east and round the world as long as they live.

So the earth turns and the seas spin, affecting profoundly the lives of all that live upon the land or in the immensity of a salt and watery world.



▲ ONE OF THE BUTTERWORTS, showing its rosette of tongue-shaped leaves. Approximately 25,000 glands to the square centimeter pour out the sticky "butter." This substance holds and digests the luckless insects that get caught (black dots visible here). The edges also curl inward to aid in digestion

**I**NSECTS that eat plants are common enough; in fact, to some of us who are gardeners they are too common. But plants that eat insects are freaks perhaps unsurpassed in interest by anything else in the green world. Among the majority of plants, the process of food getting is so orthodox as to be unspectacular, and so it is difficult to believe that there are plants that feed upon juicy insect steaks. Yet such plants are not uncommon throughout the world from the arctic to the tropics. Plants of this sort are called carnivorous or insectivorous. Some of them actually possess a kind of vegetable "stomach," comparable in its action to the stomach of an animal.

These green insect-eaters are, of course, sedentary and thus, unlike roving animals, are unable to run after and catch their prey. This fact troubles them not in the least, for they have evolved some of the most sensitive snares, diabolical traps, and wells-of-death imaginable. With these varied tricks up their vegetable sleeves, they can be

assured of an almost constant and fresh meat supply.

Carnivorous plants are eminently successful in their unusual mode of life. In fact, their leafy parts have at times become so modified that they no longer possess sufficient chlorophyll for normal food synthesis. Instead, their leaves serve as bait and are colored with attractive hues of red or purple. They are

so bizarrely modified that they might be mistaken for flowers. Furthermore, these plants are so independent of the normal sources of nitrates that they are able to inhabit extremely poor soils. About all they need from the substratum is water. Some, indeed, are wholly aquatic, such as the majority of bladderworts; but most of them must be sought in bogs or marshes, where

# CARNIVOROUS *Plants*

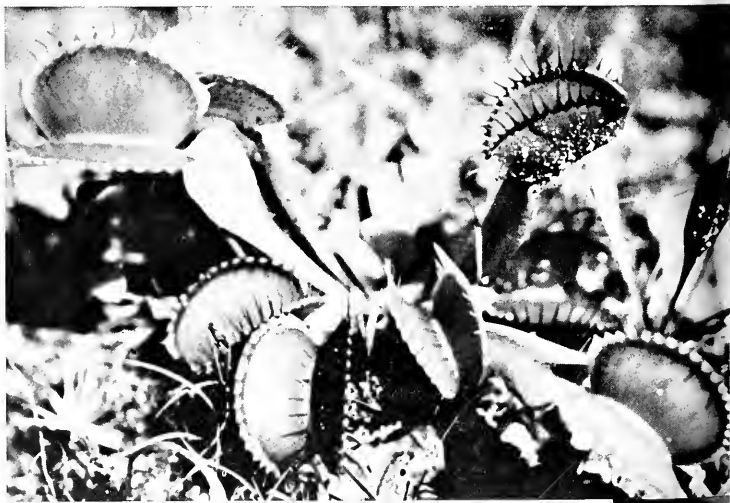
By WALTER HENRICKS HODGE

*University of Massachusetts*

*Photographs by the author*

The most curious "food-faddists" of the botanical world are an assortment of plants that capture and digest insects instead of deriving their nourishment from the soil

▼ VENUS'S-FLYTRAP, with its curious, colorful, quick-acting leaves



their weak root systems, acting merely as water pipes, are often buried in nothing more than wet mats of moss.

Of all the carnivorous assemblage the sundews, belonging to the genus *Drosera*, are the most widespread, the most numerous, and apparently the most successful—at least if abundance, world-wide dispersal, and number of species are a measure of success. Despite its ubiquity, the little sundew, because of its size, is not well known by Mr. Average Man. Yet on most every sphagnum bog, near many a springy rill, and even on many a high Andean mountainside, it spreads its expectant whorls of tiny, frequently spoon-shaped leaves.

Befitting its size, its prey consists of insignificant winged creatures—gnats, midges, mosquitoes, and the like. Woe betide any dipterous biplane that sails unwarily into its glistening leafy orbs, for it is soon ensnared in viscid blobs of glue, nature's original flypaper. Charles Darwin, whose researches on insectivorous plants are classical reading, considered the leaf of *Drosera* one of the most "incredible and wonderful" things known to him in the whole field of botany.

It pays to look closely at the structure of such a morphological gem. Sundew leaves vary in shape, being round, hairlike, or spatula-shaped according to the species, but all have a similar basic struc-

ture. Those of the common sundew (*D. rotundifolia*) are typical. Flat, platelike blades with the diameter of a lead pencil are borne on elongated, tapering petioles. From the upper surface and edges of these leaves arise several hundred green or purplish hairs, sometimes called "tentacles," which serve as the traps for insects. On the central part of the leaf the tentacles are short and stubby, but as one progresses to the margins they become much longer. Each hair is clublike at its tip, the swelling being a tiny oval gland possessing the complex digestive properties of secretion and absorption. When functioning properly, each tiny gland produces sticky drops of a fluid that glisten in the sunlight, giving to the leaf as a whole the appearance of an elfin crown studded with dozens of shining diamonds.

What happens to the gnat that flops its six-footed landing gear into this sparkling orb? Plenty! Not only its legs but also its wings and body are hopelessly ensnared by this living vegetable flypaper. In short, Mr. Gnat is in the hands of a green octopus, whose tentacles at the first touch of the insect begin a characteristic slow, bending action. This brings the hair tips as well as their trapped prey into the center of the leaf, until the leaf looks like the inflexed fingers of a clenched hand. All the hairs, with all their glands, can now effectually contact, hold,



▲ OVER the dangerous area of the glandular blade wanders an inquisitive ant. The Venus's-flytrap in the middle has already caught an ant and will soon digest it

► THE LEAF CLOSES QUICKLY, and the ant has little chance to escape from this curious botanical "stomach"





▲ A COMMON SPECIES OF SUNDEW (*Drosera rotundifolia*), spreading its expectant whorls of tiny spoon-shaped leaves



▲ THE GLANDULAR HAIRS have folded upon a tiny insect at extreme left. On the other two leaves the hairs are wide-spread. (*Drosera rotundifolia*)

and digest the insect morsel; and the hairs remain in this position until digestion is effected.

The leaf is now acting for all the world like an animal stomach, for in the temporary enclosure formed by the hairs, the glands discharge a digestive juice possessing all the properties of pepsin, the ferment produced by our own stomachs. This ferment will digest any nitrogenous insect material, and it has even been shown capable of softening such tough substances as cartilage and bone, bits of which have been placed experimentally on the leaves. When absorption is complete—after several days—the tentacles again expand, and the trap is ready to repeat the process.

When we remember that plants have no muscular or nervous tissue, the whole procedure seems remarkable. And the sensitivity of the mechanism that carries it out is perhaps unsurpassed by anything in the whole field of botany. It has been shown that a bit of ordinary hair weighing only 1/78,740 of a grain, pressing on one gland, is sufficient to cause movement of a *Drosera* hair, yet such a particle on the supposedly delicate human tongue is too light to cause any sensation! Inedible foreign particles,

upon touching the surface of a sundew gland, may cause bending, but apparently the leaf soon "realizes" its mistake and reopens quickly. The force of the wind or drops of rain cause no reaction, and so the plant is spared much useless energy; but let food in the form of an insect alight and the glands really react. Thus there is apparently both a mechanical and chemical reaction. Darwin showed that one twenty-millionth of a grain of phosphate in aqueous solution is fully sufficient to cause a reaction. Ten seconds after such an infinitesimal chemical stimulus, a tentacle will show appreciable movement; in ten minutes it may have reached the center of the leaf.

Although *Drosera* is the largest genus of a family (Droseraceae) boasting over 100 species in the temperate regions of both the Northern and Southern Hemispheres, there are other sister genera equally interesting. Most of these are rare plants with a peculiar distribution, often exemplified by local abundance in only one tiny locality on this earth of ours. One such example is a plant that has devised not the flypaper technique but rather a clever mechanical trap. This plant is the all-American Ve-

nus's-flytrap (*Dionaea muscipula*), found only on the Atlantic coastal plain, chiefly near Wilmington, North Carolina. On grassy, pine-sprinkled savannas, in the company of gaudy sabbatias, insignificant burmannias, and orange habennarias, this curious plant spreads its leafy rosettes like a bear trap and awaits whatever prey may appear. The leaves of Venus's-flytrap are more spectacular, larger, and much more rapid in action than *Drosera*'s apparatus. Furthermore, they show greater complexity of structure, for the functions performed by the tentacle alone in the sundew are discharged by three different structures in *Dionaea*.

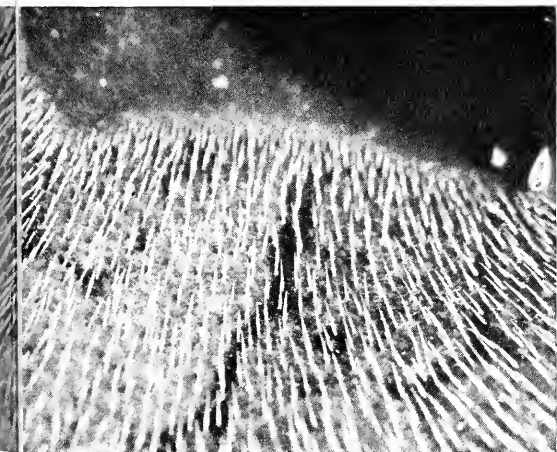
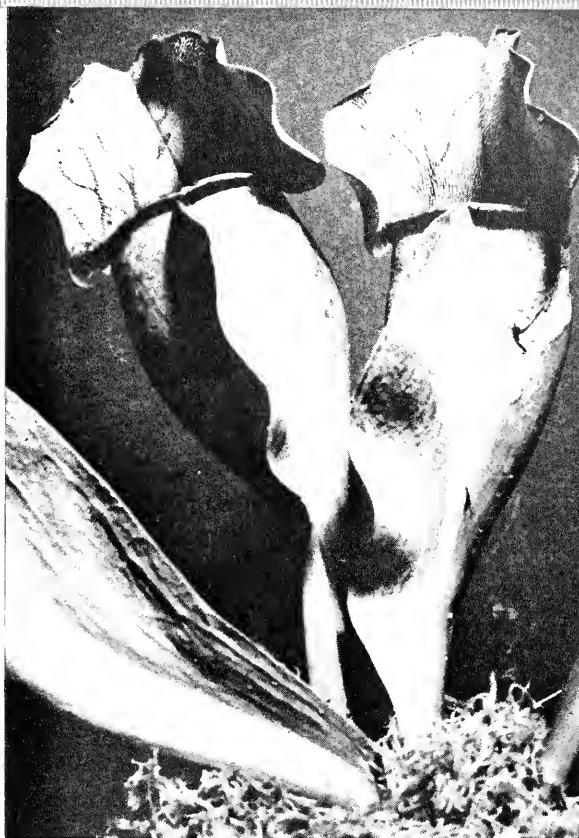
Each flytrap leaf consists of a flat spatula-like stalk which supports a roundish blade divided by a midrib into sensitive, symmetrical folding halves. The two halves are held open at an angle of up to 80 degrees. The upper surface of the blade is often colored a beautiful red owing to the presence of multitudes of minute closely-packed, short-stalked glands. Their purpose is purely secretive and digestive, although their brilliant color undoubtedly serves as an insect lure. Rising from the surface of each half of the leaf blade are usually three stiff hairs which act as ultra-sensitive triggers to set off the whole insect-catching mechanism. To complete the complex apparatus are a series of rigid marginal spines, which interlock like the teeth of a bear trap when the leaf is closed. These are not sensitive.

*Dionaea* is called a flytrap. Actually the plant probably captures more creeping insects like ants, beetles, etc., than it does flying forms. Over the dangerous area of the glandular blade wanders an inquisitive ant. It is usually safe so long as it doesn't brush against one of the upright triggers. If it does, even though the touch be momentary and slight, zip!—and within a second or two (under proper temperatures) the leaf-halves evenly and firmly close. The triggers, hinged at their bases, fold neatly flat against the leaf surfaces while the ant is firmly held. Its body



▲ THE COMMONEST AMERICAN PITCHER PLANT, *Sarracenia purpurea*, photographed in a New England bog

► THE TUBULAR, PITCHER-SHAPED leaves give the plant its name and are the organs that capture and digest insects



▲ ALL THE HAIRS of the hood near the orifice of the pitcher plant point the same way and form a shoot-the-chutes

► WHEN they are cut open and drained of water, the lower portions of the pitchers are seen to be plugged with insect carcasses





fluids, if ruptured, provide a necessary incentive for the surface glands, which immediately begin pouring out digestive fluids, and *Dionaea's* temporary leaf stomach thus goes into action. A week may be required for assimilation, after which the leaf reopens, ready for another mouthful.

Another type of meat-eating plant is seen in the butterworts—various species of *Pinguicula* (Lentibulariaceae). These fraternize with the little sundews on moors, moist peat lands, and bogs; and on the eastern Carolina savannas they may even be found rubbing leafy elbows with the Venus's-flytrap. Butterworts also spread into mountainous terrain, where they may rear their small but colorful snapdragon-shaped flowers from wet rock crannies or springy places.

The tongue-shaped leaves of butterwort rosettes look superficially more like normal everyday plant leaves, yet if one gives a leaf a microscopic look, peculiarities appear. For one thing, its whole upper surface is peppered with tiny glands, roughly 25,000 per square

centimeter of leaf surface. Any kind of pressure upon the glands by a foreign body causes them to secrete. If, in addition, the object happens to be nitrogenous, as in the case of an insect, they pour out quantities of mucilaginous and acid digestive liquid. The plant gets its common name from the fact that the leaf practically exudes "butter." *Pinguicula* also has a power of movement shown by its leaf margins. Although these exhibit a more or less permanent inrolling, the effect is increased when insects are stuck on the surface glands. By encompassing them with the margin, more secretive surface is put to work in digestion, and thus a more efficient type of temporary plant stomach comes into play.

Of all the queer insectivorous plants thus far considered, only the butterwort has found a place in man's economy. Shepherds in the Alps have long used its leaves in curing the udder sores of milch cows. The glandular secretion of the blades apparently acts as an excellent antiseptic. And on a Lapland journey over 200 years ago, the great Swedish botanist, Linnaeus, noted that the inhabitants had observed that the secretion of *Pinguicula* glands acted similarly to rennet. Indeed, if fresh milk is poured over the leaves of the butterwort, a tough mass called *taetmiolk* is formed, which is a favorite dish of those northern regions.

The all-American pitcher plants (*Sarraceniaceae*), familiar insectivorous plants common in bogs from the Gulf Coast to Labrador, have pioneered their own way of catch-

ing insects, and although the shape and style of the traps may vary in the different genera and species, they all follow a basic pattern.

The numerous colloquial names applied to the species of *Sarracenia*—pitcher plant, sidesaddle flower, trumpet, huntsman's horn—aptly describe the hollow tubular leaves that serve this genus as insect traps. Without exception the leaves are attractive organs, often brilliantly colored with purplish-red reticulations or stripes on a green or yellow background. Not only do the leaves of these curious plants resemble flowers in shape and color, but they also mimic them in the possession of nectar glands. These exude fruity-smelling fluids of honey-like consistency, which entice the most reticent of insects from afar. But pitcher plants don't stop with perfume, for in many another way they have made it easy for any insect to buy a one-way ticket to oblivion.

Just suppose a fly catches sight of the leaf of the common pitcher plant, *Sarracenia purpurea*. It immediately attempts a landing, finding to its delight a beautiful plush-like "front porch," the hood, which serves as an admirable landing field. What is more, heavenly odors (at least to an insect) exude from a portal near by. No job to walk toward it either, for all the hairs on the plant door mat are bent



◀ BESIDES a baited path of nectar and a capping hood, this pitcher plant of our southeastern states (*Sarracenia minor*) possesses thin translucent spots of tissue that fool the insects trying to escape by flying (see upper right pitcher leaf). These pitchers are often brim full with captured insects

➤ SOUTHERN "TRUMPETS" (*Sarracenia flava*), one of the tallest of the pitcher plants





thoughtfully that way! At this point the insect, having reached the sweet-smelling threshold, may be slightly punch-drunk and perhaps even staggering a wee bit on its six wobbly legs. A stumble is all that is now needed, and with it another insect is precipitated down the smoothest and most slippery shoot-the-chutes to be found in nature. At the dark bottom, the insect lands with a splash in water, foul-smelling water, for this is a cistern choked with insect "soup." In many cases the insect's wings become wet, eliminating its chances of flying out. Even if it reaches the sides, its doom is still sealed, for at the water level is another zone of long, downward-directed hairs. The watery fluid exerts a quieting influence and stupefies the prey, for it contains protein-digesting enzymes secreted in quantity by glands on the bottom walls. Epidermal cells in the same region are constantly absorbing the nutrient solution resulting from decomposition and digestion. Pitcher plants are thus really well fed.

In the job of wholesale insect slaughter it must at least be said that *Sarracenia* is humane; in fact, it has been but recently shown that this commonest of pitcher plants produces a powerful painkiller. Ammonium extracts from the leaves have been used by Philadelphia physicians for over fifteen years as injections, and they are said to be superior to alcohol or novocain in at least three ways: anesthesia from *Sarracenia* extracts does not produce numbness, does not destroy nerve tissue, and is longer acting.

The leaves of the common pitcher plant are also pitfalls for ground-inhabiting insects, for its pitchers are often deeply sunk in masses of wet sphagnum moss. In such sites only the erect hoods remain unburied. These sunken pitchers are so open to the elements that they are generally full to the brim with rain water, which dilutes the consistency but apparently not the efficacy of the digestive fluid. In most of the other *Sarracenia*s, the hoods are not erect but bent over (like a jack-in-the-pulpit spathe), acting as

capping protection to the pitcher mouths. The result is that little if any rain ever enters. What liquid is secreted is limited to the lowermost narrow and basal portion of the tubular leaf. Even with pitchers thus partly covered by a protective cap, the plants are still very effective; in fact, the Lesser Pitcher Plant (*S. minor*) of our southeast, with a helmeted cap and a baited path of nectar running from the ground to the orifice, surpasses all other species in insects captured. Its semidry pitchers are often stuffed with the bodies of ants.

This Lesser Pitcher Plant and the California Pitcher Plant (*Darlingtonia californica*) have, in addition, an interesting device for sealing the doom of insects that might be able to fly out of a fairly dry chamber. This is a "skylight" situated in the crown of the hood. This window is actually a thin, transparent spot in the tissue of the leaf. An insect flying against the window in an effort to escape is, of course, only knocked down again into the well below. Seldom does it find the opening by which it entered.

It is not strange that pitchers full of decaying insect remains should attract carrion insects. In fact, many of the latter perish in their dangerous quest. But the queer thing is that at least some of these carrion seekers actually pass a portion of their life history unharmed in these wells of death. One small fly (*Sarcophaga sarraceniae*) has the knack of passing safely in and out of the leaf traps and lays its eggs among the pitcher's insect remains. The larva of the fly, apparently unharmed and unconcerned by the digestive enzymes of the cistern, feeds upon the carrion mass and then bores through the thicker walls to pupate in the earth.

During the recent war, our fighting men in the jungles of Malaya and on the islands of the South Pacific undoubtedly ran across the most bizarre of all pitcher-bearing plants, those belonging to the oriental family, *Nepenthes*. Not unknown in our own country, species of tropical *Nepenthes* are sometimes grown for their novelty in



▲ THE VARIOUS TROPICAL *NEPENTHES* display giant-sized pitchers, sometimes large enough to hold a pigeon. The nectar-flavored margin curls sharply inward and thus prevents crawling insects from escaping. Note the hood poised delicately above

warm, moist conservatories. The plant is primarily a climbing, scrambling one with giant-sized pitchers slung in the air at the ends of the leaflike petioles, like so many Chinese lanterns. In addition to the liquid-filled chamber, pitchers of this genus possess a tiny hood and a honey-secreting margin with a sharply revolute edge, which keeps crawling insects safely within. In general pattern, the leaf of *Nepenthes* is thus similar to the predatory leaf of the *Sarracenia*s.

Quite a gamut is run from the sundew to tropical *Nepenthes*, yet these queer insectivorous plants, unrelated though they are, show harmony and similarity in at least one point—they have investigated the possibilities of a new kind of food supply, and, what is more, they have all apparently made good.



▲ AVOCETS IN FLIGHT in the type of country where they are most at home

# *Avocets Have Turned-Up Bills*

Scenes at the Bear River Wildlife Refuge in Utah

depict the home life of one of our most attractive shore birds

✦ BOTH ADULTS have the turned-up bill, but not the young. The birds wade forward in the shallow water, sweeping the bill from side to side in search of shells and other small aquatic animals



*A photo series*

*By*

HUGO H. SCHRODER

ITS sharply contrasting colors, graceful form and carriage, and long upturned bill make the avocet a bird of distinction. It is rare east of the Mississippi, being most commonly found near the prairie ponds and alkaline lakes of the interior. It constructs its simple nest on the ground among grass or low herbage, at not too great a distance from the water. Three to five eggs are laid, although occasionally more than one female will lay in a single nest.



▲ ONE OF THE PARENTS walking to the nest, which contains two eggs and one newly hatched youngster



► THE ADULT'S PLUMAGE is black and white, its head and neck brown. The legs are light blue

▼ THE MALE AND FEMALE are very much alike. The female is slightly smaller on the average, but some females are larger than some males



# Natural History CRYPTOMAZE

INSECTS, By EDWARD DEMBITZ

In this puzzle you are given a set of definitions, each with a set of blank spaces (Part I), and a diagram to be filled in (Part II).

**PART I.** Each definition is a clue to a word whose letters you are to insert in the blank spaces preceding the definition. These words appear in recent issues of NATURAL HISTORY Magazine.

- 6 31 28 19 16 35 *A mammal that a dog is named after (German)*
- 1 13 32 37 14 *What oysters do before they R in season*
- 30 13 16 7 25 2 21 *To pursue a hobby that keeps one underground (colloquial)*
- 3 9 14 34 22 10 *"Reverent" insect; the female eats the male*
- 29 33 15 27 4 26 18 7 *19th century astronomer (1818-1889); one of first women elected to Hall of Fame*
- 1 21 20 5 *Predatory bird, enemy of baby penguins on the Snares Islands*
- 18 5 28 8 6 25 19 *A male or female beetle, despite the name*
- 38 24 22 *A favorite of crossword puzzles and of Hawaiian culinary art*
- 17 36 15 31 2 12 *Australian boy named by Capt. Cook for a branch of biology*
- 27 36 29 17 *Adornment for the rooster, larder for the bee*
- 9 23 19 24 14 32 20 34 *Nautilus-like relative of the octopus; also a shipmate of Jason*
- 11 24 23 3 22 27 5 *A genus of ants, producers of pungent acid with similar name*
- 20 38 9 30 *An Australian tree that ensnares birds in its sticky fruit*
- 37 4 12 10 31 4 *An African weaverbird given to raids on grain fields*
- 11 33 35 26 11 7 8 *A light-producing beetle*

Copyright 1949 by Edward Dembitz

The contest is open to everyone except employees of the American Museum and Doubleday and Company, and their families.

**PART II.** When you have filled in all the letters in Part I, transfer them to the proper numbers in the boxes in the diagram below.

1	2	3	4	5	6	7	
8	9		10		11	12	
13	14	15	16	17	18	19	
20	21	22	23	24	25	26	
27	28		29		30	31	
32	33	34	35	36	37	38	

When the diagram is completed, the white spaces will form a word maze containing at least 18 names of INSECTS. To find one of these insects, begin with a letter and move from space to adjoining space in any direction, including diagonally, until the name is spelled out. Do not pass through shaded spaces while forming names. Do not form double letters by jumping up and down on the same square. Do not skip squares in the middle of a two-word name.

**THE PRIZES.** The three contestants submitting the largest number of names of insects fitting this puzzle will each receive a copy of Ralph B. Swain's INSECT GUIDE, recently published by Doubleday and Company.

Names of insects must appear in bold-faced type in the main A-Z section of Webster's New International Dictionary—1948 (unabridged) in order to be eligible. Names in bold-faced type below the line at the bottom of the page are allowable. Different names for the same insect will be accepted. So will variants, alternative spellings, and scientific or technical names, providing they appear in bold-faced type.

Flagrant disregard of the rules will disqualify a contestant.

In case of ties, duplicate prizes will be awarded.

Entries must be postmarked on or before July 1 and be received by July 6, 1949. You need send only your list of insects, not the "checkerboard."

Winners and their scores will be published in NATURAL HISTORY for October, 1949.

## THUNDER RIVER Continued from page 269

planted as an experiment by the Forest Service several years ago, to reach what is well-nigh the limit of size for stream fishes. One fisherman in our party took the limit of fresh rainbows in 30 minutes. The fish ranged in size from fingerlings to 21 inches, the prize catch being a speckled beauty that weighed 2¾ pounds when cleaned.

There is no likelihood that Thunder River ever runs dry, and the presence of the fishes bears this out. Originating as it does in springs, the stream has no inlet through which fish could enter. Hence it is logical to assume that the stream varies little in volume. Low water could not support fish of such proportions, and it is most unlikely that the fish

fight their way upstream from the Colorado, since its muddied waters have never been known to support sizable trout. It is doubtful that Thunder River trout migrate. Once established in the stream, it is likely that they remain within its narrow confines, which probably accounts for their huge size.

Taking a critical view of the

fishing, perhaps a word of caution is in order. While at the present time Tapeats Creek is an angler's paradise, the fish could not survive a large-scale invasion. Obviously a stream whose entire course can be covered on foot in a single day is fatally susceptible to overfishing. Hence it is important that bag limits be observed. The stream could be maintained as a sort of natural forcing ground where rainbows might be permitted to reach their present gigantic proportions before succumbing to a lure or a fly.

The fishing can never constitute the strongest magnet for visitors to Thunder River. In the final analysis, the country itself is the greatest attraction. The area has the earthy

beauty characteristic of the mesa and canyon country—an elemental beauty compounded of red and buff-colored sandstone walls set off by the silvery sparkle of spring and creek and the rich green of streamside vegetation. Lining the streams are cottonwoods, redbud, and Arizona ash; colorful blooms such as scarlet mimulus and princess plume; and a profusion of lush green ferns. It is a scenic wonderland offering in compressed form a cross section of canyon scenery unsurpassed in the whole Grand Canyon country. Viewed in this light, it is a preserve of the first magnitude; and it should be protected as an unspoiled wilderness area that will provide adven-

ture, exploration, and recreation for future generations.

Years may pass before the area is made accessible to the general public. The National Park Service may elect to hold it, like some of our undeveloped National Monuments, as a reserve against the day when the pressure of the country's population requires its development. Fortunately, the area is within national park boundaries, so there need be none of the prolonged conflict that invariably accompanies every effort to set aside areas of national park caliber. But the task remains to make certain that if and when this area is made more accessible, its wild, natural beauty will be kept unspoiled.

#### INSECT THERMOMETER *Continued from page 259*

than leave it. Like the bee, it is unable to fly at temperatures below 40 degrees.

With the single exception of the malaria-bearing mosquito (*Anopheles*) I never have seen an insect flying at a temperature below 40. All noise-producing insects with which I am acquainted are mute at temperatures above 106 and below 40, some even below 65. At the lower limit of their vocality they are silenced by the cold, but above 105 degrees, though they can be quite active, they probably remain quiet because of the intense heat. All insects of my acquaintance are motionless, though not necessarily dead, at temperatures below 32.

I have observed reactions to temperature in several species of insects other than those already mentioned but have not been able to check these with a temperature recorder. Thus the ticking of that

beetle popularly known as the "deathwatch" (*Anobium notatum*) in the walls of frame houses appears to vary with different temperatures. Then there is the firefly, or "lightning bug," common to our eastern states. Perhaps everyone has observed that its flashes are more rapid early in the night than later and cease entirely before morning. But in the open the firefly is continually on the wing, and when confined for observation it becomes nervous and doesn't work its flashlight regularly.

The "snapping beetle" (*Elater*, various species), which suggests the beetle-shaped "snapper" familiar to all children, snaps more frequently in warm weather than in cool, but it snaps its thorax only when held in a certain position and is affected by the warmth of one's hand.

I also have observed that the note

produced by the wing vibration of many insects—for example the fly, honeybee, mosquito, and bumblebee—becomes noticeably slower as the temperature falls, but the insect itself can change the pitch when frightened or angry. Every beekeeper knows, from the pitch of its hum, whether the bee that is flying about his head is angry or merely curious. The wings of the housefly ordinarily produce a note well up the scale, but I have seen them so chilled that they could not produce the lowest audible note, which means their wing vibration was less than about sixteen per second. I also have noted that when the temperature is as low as 65 degrees, the vibrations of a grasshopper's wings are nearly slow enough to be counted, but by the time the temperature has risen to 85 degrees its wings may produce an audible note.

The field offers opportunity for some interesting but unremunerative research. I believe that if the reaction to temperature of all our common outdoor insects were well known, the farmer in his field would be able to determine the temperature with a tolerable degree of accuracy almost any hour of the day. Insects are not more sensitive to temperature changes than are warm-blooded animals, but, unlike the latter, their body temperature

**Winners of the Fishes Cryptomaze** in the April issue of *NATURAL HISTORY*: The three contestants submitting the highest number of fishes listed in the main section (A-Z) of *Webster's New International Dictionary*—1948 (unabridged), in accordance with the rules of the contest, are: HAROLD EATON, Jackson Heights, N. Y.—56 fishes; DR. HENRY S. RICH, Bronx, N. Y.—50 fishes; AL ANTHONY MANTOVI, Staten Island, N. Y.—45 fishes. Each of these winners has received an autographed copy of *North American Game Fishes* by Francesca La Monte, published by Doubleday and Company.



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is practically the same as that of the air around them. Their metabolism does produce a tiny amount of heat, but it is radiated as fast as it is generated, and they can warm themselves only by exercising en masse, like the bee cluster I mentioned. Remembering how the human system is affected by a bodily temperature only two or three degrees above or below its normal 98.6 degrees, we can readily understand how profoundly an insect may be affected by a change ten times greater. When we are "chilled to the bone," medical men tell me, our internal temperature is only two or three degrees below normal.

Unlike animals, whose voices are produced by the vibration of membranes, the voices of insects are the result of muscular action, as also is the vibration of their wings, and therefore any chilling sufficient to slow down muscular movement serves to lower the pitch of both wings and voice.

The "Insect Thermometer" shown herewith is almost entirely self-explanatory. In the "Crickets' Chirps per Minute" columns, numbers in parentheses are only theoretical values, for I never have heard a cricket chirping in temperatures below 55 degrees.

The "Cricket Thermometer" pictures a little device that I once made for my own entertainment. To use it, we count the cricket's chirps for ten seconds, then bring the lower end of the pointer to the corresponding number on that cricket's scale. The upper end will then indicate the temperature of the place where the cricket happens to be. For illustration, if a black field cricket is chirping at the rate of 18 chirps in 10 seconds, we place the lower end of the index at 18 on that cricket's scale (as shown), and the upper end shows the temperature to be 65 degrees.

The third drawing is a copy of an actual two-hour record of temperature and the chirps of our friend, Mr. X. It reveals strikingly the sensitivity of that cricket to temperature changes; in fact, it surprised as well as gratified me. The chirps were counted every 5 minutes, and for



greater accuracy were counted for 60 seconds and then multiplied by 14/60 in order to obtain the number for 14 seconds. This explains the fractional chirps indicated by the chart. Thus, for the first count, at 7:30 P.M., there were 132 chirps in one minute, which reduced to 30.8 for 14 seconds. Instead of a thermograph, a telethermoscope

was used—a quite accurate instrument which measures temperature in terms of electrical resistance. On only four of the 25 counts were the chirps and the temperature record not in practical agreement. These four are indicated on the chart by short arrows. It is quite possible that the difference, which in no case amounted to more than one-fourth

of a degree, was due to a slight lag-error in the instrument and to the fact that the cricket was more quickly responsive to temperature changes than was the thermal coil of the instrument—which is not remarkable when we remember that a cricket isn't one-twentieth the size of the thermal coil of a telethermoscope.

#### BOOKS *Continued from page 246*

of the commonest as well as one of the most widely disseminated of the wasps and has engaged the attention of a number of qualified observers.

One of the special objects of Professor Shafer's inquiry was to determine the significance of the little white pellets visible through the body wall of the wasp larva and constituting nearly five per cent of the weight of the insect when it reaches maturity. But the nature and function of these pellets are too interest-

ing to be summarized briefly, and the reader is referred to the volume for an adequate account.

HERBERT F. SCHWARZ.

#### THE UNIVERSE AND DR. EINSTEIN

----- by Lincoln Barnett

William Sloane Assoc., \$2.50  
127 pp., 4 illusts.

THE brief way to express a theory is to put it into mathematical form.

A simple way to obscure its meaning is to write a long book about it. In *The Universe and Dr. Einstein*, Lincoln Barnett has hit a happy medium. He has neither written a long book nor has he delved too deeply into mathematical equations. This book is written for the nonmathematician whom Einstein described as "seized by a mysterious shuddering when he hears of 'four-dimensional' things, by a feeling not unlike that awakened by thoughts of the occult. . . . And yet there is no more commonplace statement than that the world in which we live is a



## What Bird Is This?

An unusual photograph by WALKER VAN RIPER

*Denver Museum of Natural History*

*"To Bible writers I was known;  
In few museums have I been shown.  
Like Jenny Lind of voice sublime  
I chose gay '50's as the time  
For Metropolitan debut—  
But laid six eggs of grayish hue."*

Make your guess,  
and then turn to  
page 288 for the answer.

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four-dimensional space-time continuum." By shaving off the obscuring whiskers of higher mathematics, the author, for the first time, has revealed the distinguishing characteristics of Einstein's theories.

Mr. Barnett, being a newspaperman, protects his reader from the icy chill most people feel when brought into immediate contact with abstract time and space relationships. He first prepares the reader with concrete demonstrations of the place that realism, as evidenced by our senses, holds with respect to abstraction, before stating that "it is the mathematical orthodoxy of the universe that enables theorists like Einstein to predict and discover natural laws simply by the solution of equations." Our senses of sight, sound, touch, taste, and smell might be compared with the abutments on a suspension bridge. Each abutment is separate and distinct from every other, but all are linked together by the roadway and supporting cables, which might be pictured as the abstract part of the relationship. Scientifically, the whole structure is tied together as a complete unit through the medium of the electromagnetic spectrum. Our senses sample various sections of this spectrum; scientific abstraction through the medium of mathematical equations fill in the balance of it. By pointing up the recognized limitations of man's senses, the role of Quantum physics and the mathematical process of interpolation and extrapolation are reduced to understandable simplicity. Thus the author lays the groundwork for this lucidly clear presentation of Einstein.

GORDON A. ATWATER.

## COOK AND THE OPENING OF THE PACIFIC

----- by J. A. Williamson

The Macmillan Company, \$2.00  
 251 pp., 6 illus.

THE name of Captain James Cook is one of the most illustrious in the history of the exploration of the Pacific Ocean. And this is rightly so because his achievements as an explorer and navigator in this vast region are of the first rank. But aside from his Pacific exploits, Cook is hardly known at all. Like a musician in a symphony orchestra who emerges dramatically from anonymity to play his brief solo, Cook appears suddenly in English history as a seasoned and practiced navigator to play his brilliant, eventually tragic role in the South Seas.

A man of humble birth and little formal education, he became a highly skilled navigator and chart maker largely by self-education. Entering the Royal Navy at a relatively advanced age, through the unconventional avenue of an apprenticeship on coastal colliers, he made a phenom-

nal rise in a very short time. His selection by the Admiralty to command a scientific expedition to the Pacific in 1769 seemed a logical choice after his noteworthy surveys and charts of the Canadian coast, which occupied him for a number of years and demonstrated his exceptional skill in unknown or dangerous waters.

Cook's three expeditions to the Pacific are classics of their kind. His explorations were sound and definitive. He solved several geographical problems that had bemused European scholars for centuries. His surveys and charts were unexcelled and remained the basis of Pacific navigation for many years. His accounts of what he saw of native life and natural history remain invaluable sources for modern students.

But Cook's achievements represent a culmination of a long exploratory history of the Pacific and can be appreciated only in the light of his predecessors. The merit of this entertaining and informative book on *Cook and the Opening of the Pacific* lies precisely in the fact that this historical perspective is provided. Mr. Williamson, the author, has brought forth a noteworthy character in British history and has illuminated through the career of a distinguished man the slow advance of knowledge.

HARRY L. SHAPIRO.

## Answer to "What Bird Is This?" on page 287

In 1850—the same year that Jenny Lind made her Metropolitan debut—eight pairs of this bird were brought to New York City. The birds did not thrive, and two years later more were imported. Those that survived the winter in confinement were freed in Greenwood Cemetery. They increased in the ensuing years to millions and spread over the whole country.

We called the photograph "unusual" because in fourteen years it is the first picture of the common English Sparrow that has been submitted to NATURAL HISTORY.

The English Sparrow is mentioned in the Bible. It lays five or six grayish-white eggs speckled with brown, and raises several broods each year. Even if there were only one brood each year, a pair of English sparrows could multiply so rapidly that in the twentieth year over seven billion sparrows would theoretically be hatched. Obviously, natural checks prevent this unlimited increase. In North America the English Sparrow increased very rapidly, because food was available and there were relatively few natural enemies. The population has now reached the saturation point in the available habitat. In fact, it has sharply decreased in many urban centers. Formerly, the sparrow found a plentiful supply of food in the undigested seeds in horse droppings. The advent of the automobile therefore greatly reduced the number of sparrows in cities—their favorite home.

NATURAL HISTORY, JUNE, 1949



September

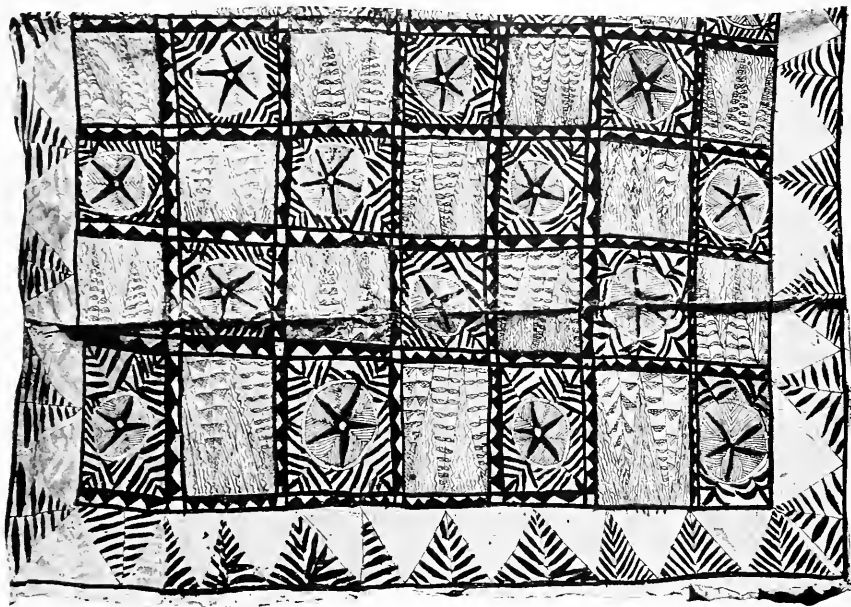
# NATURAL HISTORY

1949

*Nature's Deep Freeze • Captive Pilot Whale • Auklets*

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# LETTERS

## ***Moths Mating***

SIRS:

The accompanying photograph of a pair of *Cecropia* moths shows the male in the process of fertilizing the female's eggs. It is a picture I had sought to get during a long period of photographing our native plants and animals in their natural setting.

The picture was taken early in June. The female had emerged early in the day from a cocoon I had collected, and by evening I was able to move her out of doors. The following evening at about 8 P. M., she was discovered with the male, approximately ten feet from where she had been placed.

K. D. ROCKWELL.

Rochester, N. Y.

## ***Earthquakes — More or Less***

SIRS:

I read with great interest the article in the April issue of *NATURAL HISTORY*, "Ups and Downs of the Great Lakes," by Richard Foster Flint. It was an interesting explanation of many geographical features to be seen in the Great Lakes region, and it seems to explain the mild earthquakes that are occasionally felt in this region.

I wish to inquire whether there is reason to suppose that as the processes described in the article progress—that is, as the areas formerly covered by the ice sheet rise back up to "normal" elevation and the areas generally to the south subside and tilt back to "normal"—the earthquakes experienced in this region will tend to become more and more severe, approaching in severity those experienced in the Pacific Coast region. It would seem that the readjustments to be made in the latter region are so much greater in magnitude than those for the Great Lakes region, since the mountainous elevations involved are so vastly greater, that such a development would be unlikely. Nevertheless, I would greatly appreciate an opinion on the point.

GEORGE R. METCALF.

Eric, Pa.

The following comments are offered by L. Don Leet, Seismologist of the Harvard University Seismograph Station, to whom the author of the article defers for an opinion:

Reader George R. Metcalf has raised an interesting point. There are several lines of evidence, both from observation and from theoretical considerations, that make it highly improbable that there will be any increase in the number or severity of earthquakes caused by crustal readjustments following unloading of the ice,



even if we were prepared to admit that all earthquakes in the previously glaciated areas can be traced to that cause.

On theoretical grounds, it is practically certain that the most rapid readjustments were made at the beginning of the process and that the rate of recovery of original level decreases progressively. On the basis of historical records, the earthquake activity in northeastern North America has been cyclical rather than crescendo. At the same time, the question has been raised whether these earthquakes are really the result of crustal recovery from the ice load rather than from more fundamental, deep-seated forces, because of the striking lack of symmetry in their distribution with reference to the area covered by ice.

## ***Inter-national Interest***

SIRS:

As indication of the far-flung interest in and influence of *NATURAL HISTORY*, it occurred to me that you might be interested in the following remarks in a recent letter from my brother, Rev. Livingston Bentley, a missionary at Tabriz, Iran:

"The *NATURAL HISTORY* Magazine arrives with commendable regularity. We have grown used to irregular and unreliable mail service. Under the circumstances the delivery of *NATURAL HISTORY* has been quite satisfactory. You and the American Museum would be pleased to see what happens to it. For one thing, I took a particularly interesting copy (Paricutin Volcano, etc.) to Tehran to show to the principal and science teacher

of the English-speaking school. They both declared it to be ideal for the needs of the school and said they would subscribe. This is quite an interesting school. Though it was established for missionary children, it now contains Armenians, British, Iraqi, Afghans, Indians, Dutch, Swedes, Czechs and Chinese—20-odd nationalities drawn from the families of diplomats, government advisers, businessmen, etc. Headed and taught by missionaries, it is a strong Christian influence working in an atmosphere of international friendship. I have also loaned a lot of copies of *NATURAL HISTORY* to the nurses and student nurses in our hospital. When all the people who can really read them have seen them, they go to the boys in the Sunday School, who can't read English but are fascinated by the pictures. Your gift does a lot of good."

COGSWELL BENTLEY.

Rochester, N. Y.

## ***Needed! A Man With Vision***

SIRS:

May I comment on your admirable article, "SOS for African Wildlife." The domestication of African antelopes is not an untried solution. It has long been established that the eland, our largest antelope, being a very docile animal, can easily be tamed to suit man's requirements. (See Stevenson-Hamilton "Wild Life in South Africa" and others). It only needs a man with vision and capital to carry out this experiment on a great scale. On rock paintings found by thousands all over southern Africa, the

eland is often depicted in such a way that it suggests a more intimate relationship to man than that of hunter and prey, and some of our archaeologists are inclined to think that the people who produced the paintings had already domesticated the eland with success. Why should we not be able to do it again?

The Kruger National Park is not overstocked. Although it has suffered from semidrought conditions for the last seventeen years, it can still carry more animals than it does. This, at least, is the opinion of the warden, Colonel Sandenbergh, who gave me the information only three days ago. The graceful impala has been spreading rapidly through the Park and, being a destructive grazer, has indeed become something of a problem. Its chief enemy, the wild hunting dog, which was almost wiped out by a canine epizootic, is slowly coming back and may, we hope, master the impala problem soon.

I spent four days during Easter in Skukuza, on the Sabi River, and observed from the car two lions, one leopard, one cheeta, two spotted hyenas, one rusty genet, several thousand impala, a score of kudus, one sable antelope, one ostrich, fifty-two giraffes, nine hippopotami, one large herd of zebras and wildebeest, baboons and warthogs almost everywhere, a few little steenbuck, one pair of hushbuck, and sixty-three different species of birds. This along roads where the bush is often so thick that an animal standing only a few yards away cannot be seen. Considering that this wildlife

paradise is only eight hours run by car from the largest town in Africa south of the equator, its value cannot be over-emphasized.

DR. W. GILGES.

Johannesburg, South Africa

### America and Africa

The following note appeared in the July issue of the *Journal of the Society for the Preservation of the Fauna of the Empire*, published in England:

"Under the title 'SOS for African Wildlife,' the March number of the beautifully produced magazine of the American Museum of Natural History publishes an urgent appeal for the preservation of the fauna of the continent.

"In sending us the number in question—with a few spare copies for loan to interested members—Mr. Richard Pough, Curator of the Department of Conservation and Use of Natural Resources, writes:—'I find many people here in this country have a sincere desire to do what they can to further the conservation of Africa's fascinating mammal fauna, but it is hard to tell them what they can do. With this in mind, I should like to ask you to be sure to let me know if there ever is anything practical that Americans can do, so that I can include some mention of it in *NATURAL HISTORY Magazine*.'

"It is a difficult question to answer. Americans are alive to the fact which our own people are apt to overlook, that

the preservation of the fauna of Africa is a matter concerning the whole world, and that to allow it to be destroyed is to commit a crime against mankind. But how is that view to be impressed upon those who control the destinies of the African fauna? How can Americans intervene without apparent presumption and the risk of rebuff?

"We hope that this correctly conceived approach to the question may find expression through the International Union for the Protection of Nature. But we should prefer that British Governments, central and colonial, might take this enlightened view without outside prompting.

"Probably the most useful course the Americans could take in these ultra-commercial times would be to visit Africa in their tens of thousands asking to be shown the fauna. Let the Governments concerned be convinced that there is good money to be made regularly out of living animals in their natural state and there will be good hope of a reprieve for the condemned. Perhaps, also, funds might be made available for that extensive organized research into the problems of fly-borne and infectious diseases which have so far received such niggardly support."

August 3, 1949

### It's a Fish

SIRS:

In your article "Ancient Bushman Brushwork" (February, 1949), I note that some of the cave paintings found 200 miles from the sea are interpreted as representing a school of dolphins. Even a hasty glance at the picture shows that fish are represented and not dolphins (certainly not the dolphinfish).

It is virtually certain that the fish represented is one of the peculiar African family Mormyridae. The small, vertical caudal fin and the two pairs of paired fins, as well as the general body shape, support this opinion. It is difficult to make out with certainty which species is shown . . .

I presume that the painting of what was taken to be a marine animal 200 miles inland meant something to the archaeologist. Since instead the painting represents a fresh-water fish, the significance may be of a different sort. It is possible that the species represented lives only to the northward of the painting, but still in the interior . . .

CARL L. HUBBS,

*Scriptis Institution of Oceanography*

La Jolla, Calif.

### Best Chance Lost

SIRS:

Your readers might be interested to know that probably the best chance there ever was to study the breeding habits of the trumpeter swan has been lost.

*Continued on page 332*

NATURAL HISTORY, SEPTEMBER, 1949



Photo by A. King, from *Leon*

▲ A HERD of elephants on the way to a watering place in South Annam, Indo-China



# NATURAL HISTORY

*The Magazine of the American Museum of Natural History*

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## THE COVER THIS MONTH

Here we see the interpretation of a traditional Indian dance by one of its foremost professional exponents, Reginald Laubin, who with Gladys Laubin recently presented a program for American Museum audiences.

This dance, the Brave Heart Dance, was transmitted to Reginald Laubin by White Eyes, an old Northern Cheyenne who has since passed away. It was customarily performed to entertain visitors. A song was sung in honor of a well-known warrior, and he, in turn, was expected to sing his "vision song" and to dance for the visitors. He was free to dance as he pleased so long as he incorporated a number of conventional and symbolic movements and followed the dance song.

Evidently Reginald Laubin caught the spirit of the Brave Heart Dance from old White Eyes, for the Pine Ridge Indians have always received his presentation enthusiastically, and the old people say he dances like "old times."

The color photograph was taken by Franz Burko, of London, England.

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Atherlie E. Gidding, *Editorial Assistant*.

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# YOUR NEW BOOKS

BIRDS • YELLOWSTONE • FROGS AND TOADS  
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## THE VOICE OF THE COYOTE ----- by J. Frank Dobie

Little, Brown and Co., \$4.00  
386 pp., numerous spot drawings

THIS book is packed with material on coyotes, both original and second-hand. The author, in addition to possessing a wide personal experience with these animals, has evidently read every available account that bears in any manner upon his subject, and he quotes extensively on the behavior of coyotes. He acknowledges his indebtedness to the works of Miss L. E. Barclay, C. B. Grinnell, J. J. Matthews, and a veritable host of others. The attractiveness of the book is greatly enhanced by Olaus Murie's inimitable drawings of coyotes and other creatures.

The main subject of the book is coyote behavior, including both factual accounts, based upon numerous reports and on firsthand observations, and coyote-lore, founded for the most part upon Indian folk tales. Stress is laid upon the animals' adaptability—including a suggestion that some coyotes may be able to reason in a primitive way from cause to effect—and upon their teamwork, their curiosity, their psychology, and their "singing." Instances are given of coyotes coming in the dead of winter to houses to be fed and of the ensuing friendships between them and their human benefactors.

A full 50 pages of the book are devoted to coyote legends. The coyote loomed large in the symbolism of the American Indian tribes, and Mr. Dobie tells tale after tale, some of them after the order of Uncle Remus and Br'er Rabbit.

The biological portion of the book is chiefly assembled in a single chapter. Dens, mating, raising pups, scent, food, hunting, the different kinds of coyotes and dog-coyote hybrids are some of the subjects considered.

It is plain that Mr. Dobie likes coyotes—at least in moderation—and that he is a true conservationist. He has no kind words for poisoning campaigns, which

bring death not only to the coyotes but to innumerable other creatures of our North American fauna. Nor does he spare the latest type of "sportsman" who shoots from low-flying airplanes. His story of the "King Ranch" (p. 51) probably illustrates his own views on the subject of live and let live, or balance in Nature. The young sportsman was denied permission to shoot coyotes on the King Ranch because they were needed to "keep the jack rabbits down." When he wanted to shoot the rabbits, the answer came, "... we've got to have the jack rabbits to feed the coyotes."

The book is copiously documented, and there is a useful index.

G. H. H. TATE.

## HANDBOOK OF FROGS AND TOADS OF THE UNITED STATES AND CANADA

----- by Albert Hazen Wright  
and Anna Allen Wright

Comstock Publishing Co., \$6.50  
640 pp., 125 plates, 37 maps

FROGS and toads are ubiquitous in the United States—even the dryer deserts and the higher mountains are likely to be inhabited by one kind or another, and there is scarcely a person in the country who is unacquainted with the "local toad." Because of its importance as a laboratory animal or as a factor in pest control, the tailless amphibian has some impact, however indirectly, on the lives of most people.

It is not inappropriate, therefore, that a 640-page book should be devoted to the frogs and toads of the United States. The Wrights seek to provide the public and the scientist with information that has been accumulating since America was first settled. Like the better modern handbooks, it includes means of identification (of eggs, tadpoles, and adults), as well as descriptions of the voice, habits, habitats, breeding, and behavior. Distributions are indicated by means of 37 maps, which include three to show life zones and rainfall in the United States.

After more than 40 years devoted to the study of approximately 60 species of American frogs, the Wrights find many problems unsolved: "In a book of this sort evidence ought to be presented with not too much youthful certainty or elderly obstinacy." Stress is laid on the necessity for studying living animals, and no one is in a better position to insist on this than the Wrights, who have personal field knowledge of virtually every species discussed. They have little patience with such dubious investigators as the chap who dug out a few ancient specimens in alcohol and then talked familiarly about the supposed frog he had heard call along the Wabash River.

There are shortcomings, of course, but scientists and the public alike will welcome the advent of a book that only "the Wrights of Cornell" could have written.

C. M. BOGERT.

## GEOLOGY

----- by H. H. Read

Home University Library, Oxford  
University Press, \$2.00  
248 pp.

TWO years ago Dr. H. H. Read came to the United States by invitation to address the Geological Society of America, a recognition of his remarkably successful effort to interest geologists in the problem of the origin of granite and in the work that has been done by leaders in many different lands over a long period. His summation of the situation revived controversy and interest among geologists in this special field. This little popular book should be equally successful in stimulating the interest of the lay public in the subject of geology.

The book is not a textbook, as are most of the elementary geological works. It is more of an essay, rather long it is true, but more literary than statistical. For this reason, it should be well received by adults who have not taken geology in college and who do not plan to study the

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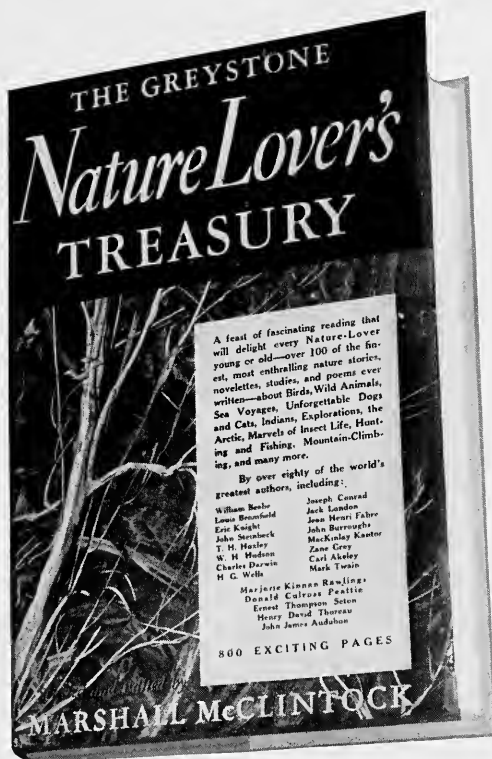
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subject. It is just good reading; and at the same time it makes clear many of the earth's features and geologic history about which any observant traveler will have wondered.

The illustrations are all diagrams and number only 30. The chapter sequence starts with sediments and the historical development of man's familiarity with his home. The igneous rocks and the inner forces enter later, along with explanations of the contortions of the crust that have made the mountains. The development of life and evolution is adequately but briefly treated near the close.

The American reader may be unfamiliar with some of the British localities that naturally come to the author's mind for illustration, but this is about the only criticism one can make of the book. Dr. Read has made an excellent job of producing a really original approach to geology for the general reader. His brief bibliography at the end suggests more technical books for those who wish to follow the subject further.

F. H. POUCH.

## THE VALLEY OF FLOWERS

----- by Frank S. Smythe

W. W. Norton & Co., Inc., \$5.00  
325 pp., 16 illu.

**T**HIS is a book about mountain climbing and about the fascinating flora observed and collected during a sojourn in the high Himalayas. The author is a skillful mountaineer, a good field botanist, and a person sensitive to the beauties about him. He writes well and is rather more successful in holding reader interest in the day-to-day events than is usually the case with books of this nature.

The book will make its greatest appeal to those rugged souls who can not be content to stay at the bottom of a mountain if there is any possible way to get to the top. These pages show how severe a demand the Himalayas place upon the human organism and how clever and daring a man must be to conquer them. But if the reader chances to hold the belief, ascribed to Van Dyke if memory is not at fault, that the only good reason for climbing a mountain is something very, very disagreeable at the bottom or something very attractive at the top, then this book affords the very pleasant pastime of climbing by proxy. Few of us will be tempted, after reading it, to go and do likewise.

But apart from the vicarious thrill of panting up perilous ridges, inching over treacherous slopes, or trusting to fingers and toes to keep one's self from falling off into the landscape, the reader can revel in splendid mountain scenery and the beauties of a plant association that must be vigorous indeed to endure the ice, snow, and long periods of low tem-

peratures. Held in suspended animation for most of the year by the rigors of an environment one might well think fatal to plant life, these hardy mountaineers spring to active life when the brief cycle of sun-inspired growth arrives. As if to recompense themselves for such a dismal existence in the dark, cold earth, the plants go on an orgy of bloom, as well they must if seed is to be set and the species perpetuated. The author had a definite program to make the most of this fleet harvest period, and the flower lover will find particular enjoyment in the pages telling of the flora.

There are 16 illustrations in full color. They are striking and beautiful as a whole, but a few suffer from faulty registration and poor color rendition.

H. E. ANTHONY.

## ALONG YELLOWSTONE AND GRAND TETON TRAILS

----- by Joyce R. and  
Josef Muench

Hastings House, \$2.75  
101 pp., 99 illu.

**R**EPRODUCED in sheet-fed gravure are 110 excellent reasons why the uninitiated must journey to western Wyoming and the answer to why those who have already visited Yellowstone and the Jackson Hole country almost always long to return. This writing-photographing team have provided a brief text by way of introduction and a series of highly artistic camera glimpses of the Mammoth Hot Springs, the geyser basins, Yellowstone Lake, the Tower Falls area, and the Grand Canyon of the Yellowstone. Interpolated is a sequence portraying the Teton range, mostly from levels easily reached by tourists. These are the peaks that "look as mountains really should," and the reviewers' only complaint is that more pictures of them were not included in this collection. The thousands who each year visit Yellowstone and the Tetons will cherish this book and let memory color the sky, the trees and rocks, the meadows full of wild flowers.

LORUS J. AND MARCERY J. MILNE.

## BIRDS: A GUIDE TO THE MOST FAMILIAR AMERICAN BIRDS

----- by Herbert S. Zim  
and Ira N. Gabrielson  
Illustrated by Gordon Irving

Simon and Schuster, \$1.00  
157 pp.

**I**NTENDED for the beginner, this little pocket bird guide contains colored illustrations of 112 of the most familiar or characteristic American birds. Tiny distribution maps show the seasonal occur-

rence of each species in the various parts of the United States. A paragraph of text on each page gives the more important facts about the bird figured, and compares it with related species. The introductory pages tell why, where, and how to observe birds. As might be expected from the authors' background, conservation is emphasized. For the more serious student there is a discussion of bird photography, bird banding, and other worth-while activities. As a first step in field identification, the principal groups of birds are listed and characterized. Data on migration, nesting habits, and food have been gathered into lengthy tables.

From the foregoing it will be evident that the authors were guilty of no great exaggeration when they wrote: "This book is crammed with facts. The more you look, the more you will find." However, most bird students, especially experienced ones who already know many of the "facts," will be attracted chiefly by the excellent colored illustrations based upon paintings by Gordon Irving. Executed with care and skill, they reflect careful observation both of birds and of the many native plants used in the colorful backgrounds. Only occasionally does either the draftsmanship or the color reproduction invite adverse criticism. No one interested in American birds will regret spending a dollar for this book.

DEAN AMADON.

## THE GREAT HORSE OMNIBUS

- Edited by Thurston Macauley

Ziff Davies Publishing Company, \$5.00  
462 pp., 33 illu.

THIS collection of narratives relating to the horse have been selected from the works of no less than 67 well-known authors, with whom most readers are familiar. The point to be stressed, however, is that Mr. Thurston Macauley was able to select stories and sketches from many books that only touched upon horses *en passant*, without equine matters being their main theme. Thus it differs from most anthologies heretofore compiled for presentation to horse lovers.

The subtitle "From Homer to Hemingway" informs the reader that he will follow throughout the ages anecdotes and narratives that cannot be described otherwise than as an excellent potpourri. Nevertheless, each of the chapters has its points of interest for horsemen who, taken as a whole, seem never to tire of talking of horses or of reading what has been written about them. This applies whether the reader of this book peruses the 46 pages of "Tale of the Gypsy Horse" or only the two pages devoted to "Man O' War."

As is pointed out in the Foreword,

some of the excerpts are necessarily brief in order that this work should not become unduly extended. However, this does not apply to "A Footnote to Horse Racing" by John I. Day, Jr., of the Thoroughbred Racing Association, whose 38 pages are a delight to read because of the valuable data they contain regarding the thoroughbred—past and present—in its relation to Racing as we know it today. An equally instructive Appendix gives a list of Derby winners and other statistics of interest.

This anthology is well written and beautifully illustrated, and it should receive its proper place in contemporary Horse Literature.

A. P. FACHRI.

## BIRDS IN BRITAIN

----- by Frances Pitt

The Macmillan Co., \$7.25  
576 pp., 16 colored plates, 49 black-and-whites

IN this large volume, Miss Pitt, a nature columnist for a London paper, has attempted to present "a survey of the bird life, wild, feral, and domestic in Britain . . . with the special view of assisting the recruit to the study of ornithology." A lengthy introduction of some 90 pages considers a wide variety of topics about birds, including even such technical questions as the "formation of geographic races." The remainder of the book is devoted to informal accounts of the birds of Britain based largely upon the author's extensive ramblings in the British Isles and on the continent.

A painting of the British Goldfinch by Winifred Austen is used as a frontispiece. Sixteen other colored plates by Roland Green portray most of the better-known British birds; a number of species have been grouped on each plate. The book is further illustrated by a multitude of photographs; so many that even the author lost track of them and used the

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# NATURE'S DEEP FREEZE

By HAROLD E. ANTHONY

*Chairman and Curator, Department of Mammals  
American Museum of Natural History*



THE SKIN of the baby mammoth fitted snugly into a Home Freezer of eight cubic feet capacity (*above*). The skin of a five-months-old African elephant of comparable size was folded into a similar position for comparison (*lower left*). The mammoth (*right*) lacks ears and hair, lost either through damage in the long ago or by more recent events. Lumps behind eyelids may be eyes.

*AMNH photos*







*From a painting by Charles R. Knight, in the American Museum*

▲ RESTORATIONS of the Woolly Mammoth owe their fidelity to the existence of the actual hair and flesh of this rugged denizen of long, bleak winters and brief summers

Out of the frozen past comes a brilliant discovery—part of a creature in the flesh—to evoke tangible thoughts of a distant era when the Woolly Mammoth roamed the north

THE average person finds it fascinating to speculate on the animal life of the past, particularly on those creatures that have disappeared from the face of the earth and are known today only from fossil remains. Fortunately for popular education, extensive collections of skeletal material tell us a great deal about the vanished animals of the past, and comparison of the fossils with animals living today enables the specialist to restore parts not completely preserved. But no matter how logical and convincing these restorations may be, they cannot make as dramatic an impression either on the scientist or the layman as does an ancient animal in the actual skin and flesh.

Certain special conditions must occur, of course, to check decomposition of a fallen animal and ensure its preservation more or less intact down to our own time. But discoveries of this sort have been made from time to time, and surprisingly enough, the arctic does

not hold a complete monopoly on them.

In Starunia, Poland, for example, specimens of the Woolly Rhinoceros have been preserved from glacial times in a silt impregnated with salt and crude oil. Some decomposition took place before the tissues were completely embalmed, but the carcasses that have been excavated can still be regarded as animals in the flesh. The hair, which had come away from the skin, was recovered from the silt in sufficient quantity to show length, texture, and color. These fossils, therefore, give a very exact idea of how the Woolly Rhinoceros appeared when alive. No imagination is required to surround the bones with flesh and finally to clothe the animal in hair.

But nature's most effective method of preserving animal tissue for tens of thousands of years is the same as the one we use today, namely sustained low temperatures. No doubt there have been many areas where animals of the distant

past have been frozen at death and given the required refrigeration to preserve them indefinitely. But in the great majority of cases, sooner or later, and usually sooner, nature's icebox has been accidentally defrosted. The carcass has then thawed and, with the passage of time, only the bones have persisted, at best. The missing parts are never seen by human eyes.

In certain regions of the far north, however, these initial refrigerations have never thawed. Summer temperatures have not been high enough or of long enough duration to melt the ice and frost more than a few inches below the earth's surface. If a frozen carcass acquired only a thin blanket of silt or ice while it lay at the surface, there was a good chance for it to survive in the flesh. In time, the covering would increase through snowfall and mud from spring floods, and eventually there would be the typical tundra blanket of grasses, mosses, and lichens to protect it further. In that event, the animal became a part of the permafrost zone, a layer of perpetual frost often some hundreds of feet thick. This zone might be called nature's deep freeze, because it is truly deep



THE HYDRAULIC OPERATIONS are a dramatic demonstration of the mass screening of a landscape, whether for fossils or gold. At Cripple Creek the "giant" strips off sun-softened muck. Huge dredges sift through the stripped gravel clear to bedrock

*United States Smelting Refining & Mining Co.*

*Peter Maas Photo*

both in space and in time. It has been in existence perhaps hundreds of thousands of years and should persist for untold thousands into the future. The thought of what may exist in this vast icebox if only man may raid it is a most intriguing challenge to the imagination.

The fact that frozen mammals have been discovered in Siberia is well known to the average reader. Reports of these finds reached Western Europe centuries ago. Perhaps the earliest firsthand report was brought by Ides, a Dutch traveler who crossed Northern Siberia in the interval between 1692 and 1695. Peter the Great of Russia, in 1722, sent orders to Siberia to secure a mammoth in the flesh, but it was not possible to recover a complete specimen. Some of the early discoveries were of entire animals, but they were slowly exposed on river banks, and travel was slow over the vast wilderness areas in that day. As the frozen flesh thawed, it was promptly devoured by polar bears, wolves, foxes, and other carnivorous animals. In some cases, several years passed before a partially buried animal completely thawed and the last of the soft parts disappeared. This in itself indicates how favorable this northern climate is to the preservation of animal tissue by freezing.

The classical example of the Siberian discoveries is the Beresovka Mammoth found on the Beresovka River, a tributary of the Kolyma. This was apparently an entire specimen of the Woolly Mammoth when first found in August, 1900, by a native. He was led to the spot by his dog, which



was attracted by the odor of what was to it edible flesh. Wolves had already been working on the carcass. Not until September, 1901, did a competent scientist reach the spot and start excavation, and some damage had been done by predatory animals and by putrefaction. It is possible to draw some interesting and rather precise deductions from the circumstances connected with this specimen.

A landslide had exposed the body, which was "sticking partially out of the ground." The carcass rested on an ice bank embedded in frozen earth, and its position was that of an animal struggling to get out of a pit. A broken foreleg and fractured pelvis indicated an accident, such as a heavy fall. This was a sudden event, for there was half-chewed food in the mouth. Very likely the fall brought a shower of earth with it, which smothered the mammoth at once. The time of the accident was late summer or early fall, because the grasses in the stomach had seeds on them.

The Beresovka Mammoth was carefully removed, skinned, and sectioned to permit transport, and finally reached St. Petersburg. It was mounted and placed in the museum of the St. Petersburg Academy of Science, posed in the attitude in which it had been found, struggling to extricate itself.

Fossil remains of the Woolly Mammoth have been reported from Alaska over a period exceeding a century. The explorer Otto von Kotzebue, on his voyage of discovery in 1815-18, wrote of the quantity of mammoth's teeth and bones exposed to view by melting ice. Since that time numerous finds have been made of bones, teeth, and huge curved tusks. But discoveries of mammoth remains in the flesh are meager, as far as Alaska is concerned. The record for arctic America does not approach that for Siberia. In 1929, Tolmachoff reported no less than 34 frozen mammoth carcasses known to him. It is possible, however, that Alaska's score may rise in future years.

There is sufficient evidence to show that the mammoth was not uncommon among the animals of Alaska in Pleistocene times.

The most productive areas may prove to be the regions north of the Arctic Circle, as has been the case in Siberia. But modern methods of mining have greatly accelerated exposures in the region of Fairbanks, Alaska. These operations are opening up formations that might have remained unexplored for decades if left to the normal climatic forces. The Fairbanks Exploration Company, a subsidiary of the United States Smelting, Refining and Mining Company, has been operating hydraulic dredges there for several decades. The

gold-bearing gravels lie beneath a stratum of muck, which must be thawed and washed out of the way. This operation at any one place may require a year or more. Acres and acres of surface are systematically exposed, and this is going on in a number of sites. The turnover of muck is proceeding on a vast scale.

In 1929, arrangements were made by the Frick Laboratory of the American Museum with President Charles E. Bunnell of the University of Alaska to single out and salvage desirable material uncovered in these stripping operations. The hearty co-operation of the Fairbanks Exploration Company made this a very successful venture

from the start. The great interest shown by these organizations has resulted in the accumulation of a very large collection of bones of various animals and an occasional specimen with skin and hair attached. Mr. Roy B. Earling, in charge of the Alaskan operations, and the members of his working force are continually on the watch as new surfaces are exposed.

The first Museum expedition went to Fairbanks in 1929, and the field work was under the direction of Mr. Peter Kaisen, an experienced veteran in field practice. In later years, the collecting has gone on without the necessity of sending parties from the Museum. Mr. Otto W. Geist, a resident of Fairbanks, has been the active collector working in conjunction with Messrs. Bunnell and Earling, and conditions are favorable to make the most of whatever is uncovered.

Perhaps the first Woolly Mammoth "in the flesh" to be recorded from Alaska is one that L. S. Quackenbush examined on his expedition of 1907. This specimen was found in a bank near Elephant Point, Eschscholtz Bay, and by the time excavation was completed, not much of the softer tissues remained. Pieces of soft flesh, tendons, some skin and hair, and finally the "end of the tail encased in skin and hair" are mentioned in his report. This latter item seems a fitting souvenir of a vanishing mammal, but it does not tell us much of the part that vanished.

Now the latest find to qualify as mammoth in the flesh really brings us face to face with the animal. This specimen is the skin covering the face and one forelimb and also the trunk. The animal was a baby in its first year and was washed out of the muck on Fairbanks Creek, August 28, 1948, by the Fairbanks Exploration Company. By coincidence, a baby African elephant, said to be about five months old, recently flown to New York, died before it could be conditioned to a zoo existence and was presented to the American Museum by the Trefflich Bird and Animal

▼ PETER MAAS sets about removing the limb bone of a mammoth exposed in the muck of Goldstream Creek. Durable specimens can survive washing from a bank, but anything fragile is menaced by the high-pressure stream

*Peter Maas Photo*





▲ **TUSKS.** The Fairbanks area must once have been the home of many mammoths



▲ **VANISHED CREATURES** that once roamed the Alaskan scene: a small-scale model showing how much was lost to us at the close of the Ice Age

Company. The distance from eye to eye in the baby elephant is nine and one-half inches, as compared with ten inches for the baby mammoth. The undernourished elephant weighed 169 pounds; a fair guess for the mammoth would be 200 pounds. The mammoth is more nearly related to the Indian than the African elephant, but for a gross comparison the African animal is sufficiently close.

This mammoth skin had some flesh and connective tissue adhering to it, but the skull and limb bones had dropped away. The water that washes the muck after it is thawed by the sun is under high pressure. If the specimen as it reposed in the bank was anything more than the blanket of skin and trunk, the jet of water scattered any other parts before the unique character of the material was known. The water is loaded with black mud after the stream washes into the muck, and objects in the runoff are difficult to detect.

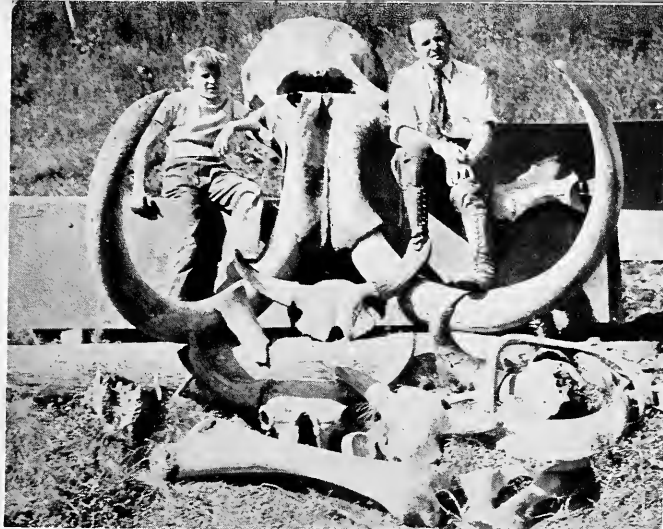
The skin and trunk were embalmed, sent by air express to the American Museum, and stored in a cool place. On June 14, the special exhibit featuring this material and a few other samples of Alaska's Pleistocene fauna was opened to the public in the 77th Street Foyer. The baby mammoth was placed in

a Home Freezer and kept at a low temperature, which simulated the condition under which it had been preserved for so many years.

How long the creature may have been preserved in nature's deep freeze is a matter of conjecture at best, but the evidence permits us to set limits within which the baby mammoth must have had its day on earth. A conservative estimate places the extinction of the Woolly Mammoth at some 15,000 years ago. But this species first appears well back in Pleistocene time, and its sojourn in Alaska is measured in the hundreds of thousand years. With the mammoth parade passing across the Alaskan stage for so many years, it is not easy to say just when one animal dropped out, particularly if it came from an undisclosed site in the muck and was discovered with other debris at the foot of the bank. Certainly thousands of years have passed since the baby mammoth lived and breathed, perhaps tens of thousands, possibly a hundred thousand years or more.

And there were many features of this time that have passed with him. The fauna then included the horse, the mastodon, a huge bear larger even than the giant Alaskan Brown Bear, a large wolf unlike any living today, a large lionlike cat, a huge-

horned bison, a camel, an antelope resembling the present-day saiga of Russia, and two extinct relatives of the musk ox, not to mention species that are still living in Alaska. Prior to the discovery of the baby mammoth, the Museum had received from the Fairbanks muck the following specimens showing skin and hair: the foot of a horse, the foot of the super-bison, the foot of a young mammoth with long reddish hair, and nearly the entire carcass of an extinct musk ox. This material was dry and hard, and it would be misleading to describe it as "in the flesh." It may have been frozen in the muck at one stage, but if so, it dried out as soon as it thawed. It is not known why so many animals of this late Pleistocene and early Recent fauna became extinct. Climatic change is often evoked to account for disappearances of this sort. Considering the continent as a whole, it is true that there were marked oscillations, with mild periods alternating with cold. The ebb and flow of ice sheets, which varied from 2000 to 10,000 feet in thickness, pushed faunas and floras over wide areas during this time. But the continental ice sheet did not reach the Fairbanks region, and the published discussions on climatic rhythm in that area are not in com-



*Photo by Griffins Studio, Fairbanks, Alaska*

▲ THE CLEARY CREEK MAMMOTH SKULL, now in the museum of the University of Alaska, is a fine example of the finds exposed by stripping

plete agreement. Some writers conclude that the climate was much milder than at present at the time when the vanished fauna prospered, and prosper is certainly the word, as shown by the abundance of bones. Others argue that the climate during the time in question could have been pretty much as it is now, pointing out that there were plants identical with those of today.

Let us consider how a mammoth would have fared if it had been living in Alaska's present climate. It was well protected against cold by its woolly covering and long outer pelage, up to 20 inches in length. Under the skin, nature provided a layer of fat up to three inches or more. The animal fed on grasses in the short summer, pulling them up with its trunk, which terminated in two lobes capable of grasping. In winter it browsed on shrubbery, the bark and twigs of trees, and probably mosses, as does the caribou of today. Both caribou and moose survive the present Alaskan winter despite the heavy snow and the low temperatures. It seems hardly necessary to have a milder climate in order for the mammoth to exist, and a milder climate would lessen the likelihood of a carcass being frozen and held intact for thousands of years.

The present muck deposits in the

Fairbanks region are explained by geologists as the result of a two-phase cycle. The first phase was brought about when the original Yukon drainage system was blocked by glacial ice. This caused the streams to become sluggish and lakes to form, in the bottom of which great silt beds were deposited. The second phase followed the melting of the ice barrier and perhaps some surface uplift. The stream gradient increased, and the present Yukon-Tanana drainage system was established. During this period, erosion by flowing water was rapid, and silt was washed down into the valleys to form a muck, which happily includes considerable amounts of plant and animal material and ice. There is an apparent odor of organic decay when the muck thaws today.

Especially during spring floods, organic material could be covered in these chilly deposits. It was a time when unwary creatures might easily be entrapped, especially a heavy animal like the mammoth, during spring floods. Furthermore, this shift of deposits might well include mammals entombed earlier in the original upland muck; but such a journey down a swollen river could hardly favor the preservation intact of any frozen carcass. A specimen of this sort, thawed

from a bank and tumbled downstream to a new resting place, would almost certainly lose in the process.

Under a climate similar to the present, the heavy mammoth might bog down and be buried during spring freshets. Or it might break through thin ice into a pit in the muck, or die in the winter and become so covered by snow, ice, or spring mud that the initial freezing never relaxed. A landslide along the bank of a stream at the spring breakup would cover it and put it in the zone of permafrost.

Primitive man was contemporaneous with the mammoth in Europe. He drew pictures of the animal on cave walls. No doubt man was co-existent with the mammoth in Alaska. But we have far less evidence of early man than we do of the mammals among which he lived. This scarcity of human remains may be due to a higher degree of intelligence: man avoided the dangers that destroyed and preserved stupid mammals. Or man's methods of disposing of his own dead may have been a factor. Perhaps he was simply not so numerous as the other animals. But in considering the latent possibilities of the frozen Fairbanks formations, one cannot overlook the chance that man himself may be included in the list of Alaska's frozen relics.

It will be interesting indeed if a human being comes from nature's deep freeze. One is tempted to predict that his appearance would be in keeping with the times and with the Woolly Mammoth—in short, that he should surely be a man with hair on his chest. But the Mongoloid peoples who inhabit most of the arctic regions today are not nearly so hairy as the Caucasians of the temperate zone, and we may be fairly sure that even at that distant date, man in the far north lived more by his wits than by his natural protection from the elements. His intelligence probably made him a match for the towering mammoth. And if brains and brawn ever came to a deadlock, we might even someday find both together, in a double knockout.

➤ PANIC must have played an important part in driving the animals ashore. They lay helter-skelter, exhausted by efforts to reach deeper water

▼ WHEN two had been placed in the truck, they were liberally sluiced with sea water to forestall heat stroke



▼ AS PROMPTLY AS POSSIBLE, they were lowered into the oceanarium. Both swam well, but only one survived longer than eight days



When 46 pilot whales were driven by some unknown terror upon a Florida beach, one was successfully transferred to the famous oceanarium. Hundreds of visitors have been entertained by his interesting behavior, and he has given scientists an opportunity to study him at close range

By HENRY KRITZLER

Associate Curator, Marine Studios

Photographs by JAMES J. BOWE, Marine Studios

THE stranding of the pilot and false killer whales is an event that occurs not infrequently on ocean shores in many parts of the world. Indeed, the natives of the Faroe and Orkney Islands make sure of a winter food supply by driving schools of pilot whales into shallow waters, where they are dispatched easily. But, for causes unrelated to human activity, these cetaceans, which share with several other species the common name "blackfish," may run aground almost anywhere. Such landings take place periodically on the coast of southeastern United States.

Apparently no one witnessed the stranding of some 46 pilot whales on the beach about 8 miles north of Marineland, Florida, on October 7, 1945. They must have come ashore during the early morning hours, because when they were discovered at about 7:30 in the morning, the tide was almost at the ebb. Most of them were lying quietly just above the low-water mark, exhausted by vain attempts to return to deeper water. The writer, probably the second person to reach the

scene, found them at about 8:00 o'clock, when the tide was just beginning to turn.

The distribution of the whales on the beach gave every indication that panic must have played an important part in driving the animals ashore. They were scattered helter-skelter over approximately a mile of the beach. There were two main groups at the extremes, with a few individuals scattered in between. One large bull, stranded below the low-water mark, had already expired, but all the rest were

## THE PILOT

still living. The surf was moderate, the sky overcast. There had been no storm, so the stranding could not be attributed to inclement weather, which occasionally drives individual whales of various species ashore. It was thought that the one bull had drowned, having grounded in water too shallow to permit him to right himself and yet deep enough to cover his blowhole. On





# WHALE AT MARINELAND

none of the whales could we see any of the abrasions usually found on the bodies of helpless cetaceans tumbled ashore by heavy surf. They had clearly beached under their own power.

At the time of my arrival, they were all lying quite still. The silence was broken only by the sound of the surf as the tide turned and by the breathing of the whales.

However quietly they lay, they were definitely not asleep, as could be seen in the active movement of their free eyes. All were lying on their sides, the shape of their bodies rendering any other position impossible. It was interesting to note how sensitive their skins were. The lightest touch immediately evoked closure of the free eye. This sensitivity has since been borne out by

the behavior of a pilot whale recently kept at Marine Studios. This specimen, a male, was the smallest of the group, measuring about seven and one-half feet in length. The largest, also a male, was just under twenty feet long. The sexes were nearly evenly divided, and none of the females (some of which were as much as fifteen feet in length) was in milk. This supports the



◀ WITH THE NEXT TIDE, most of the pilot whales remaining on the beach were soon awash. But their efforts to reach deeper water only worked them into the sand

► THE LARGEST, a male, was almost 20 feet long. The biggest females measured about 15 feet

▼ THE MOUTH forms quite a cavern, for the snout is short and the head wide. The pilot whale is more tadpole-shaped than its cousins, the dolphins



theory that pilot whales enter southern waters to mate, whereas calving takes place in higher latitudes.

I noted quickly that two of the animals were no larger than medium-sized dolphins and could therefore be easily handled. At the nearest telephone, I called for a truck, padding, a sling, and a number of men. While awaiting the arrival of this assistance, my companion and I shuttled back and forth, pouring water over the two to keep them from overheating. Cetaceans lack sweat glands (which would, of course, be superfluous in

the sea), and being warm-blooded animals are therefore at a terrible disadvantage when removed from their native element. They cannot rid themselves of excess body heat, which accumulates rapidly. Aside from the heat produced for maintenance of the normal body temperature and by muscular exertion incident to the struggle, they absorb heat from the sun. This rising temperature is one of the common causes of death in stranded whales.

When help arrived, the two small whales were lifted on the sling and placed side by side in the truck. They were liberally sluiced with sea water, and a tubful was taken along so they could be sprinkled en route to Marineland. There they were hoisted from the truck and released in the oceanarium. Both swam well and seemed none the worse for their experience.

I immediately returned to the scene of the stranding, accompanied by Mr. James J. Bowe, who made the photographs illustrating this account. By this time the tide had begun to mount and most of the

whales were awash. As the water splashed about them with each incoming wave, those that still had enough strength threw themselves about violently in vain effort to extricate themselves. This thrashing served, in the main, only to anchor them more securely, for they sank deeper and deeper into the soft sand. They swallowed quantities of sea water and regurgitated it promptly. The inevitable drownings were witnessed as blowholes were submerged in the rising water. The huge flukes were tossed high in the air as they buffeted the beach with their tails. By noon more than half the number had expired.

We revisited the scene in mid-afternoon, when the tide had receded enough to permit motoring on the beach. Many of the smaller specimens had by that time been driven nearer the high-water mark. A great crowd of sight-seers was at hand, many of them anglers having their pictures taken, rod and reel in hand, seated on the prostrate carcasses. Seldom do disciples of Izaak Walton have such an oppor-

tunity to secure photographic "evidence" in support of their fish stories.

Since the two young males that had been placed in the oceanarium in the morning seemed to be doing so well, it was decided to take one or two more. So, with the aid of a number of onlookers, a ten and one-half foot female was lifted onto the truck and, in another half hour, was swimming between the two young males in the tank at Marine Studios. A fourth, a female slightly less than nine feet in length, was taken in the late afternoon. Little hope for the survival of this last specimen was entertained, because she had an enormous sunburn blister on the upper side—eloquent testimony of the more deep-seated heat stroke to which she presently succumbed.

Of the remaining whales, one, a male about twelve feet long, was hauled to a service station as a tourist attraction. In the course of the next few days, great quantities of formaldehyde were pumped into the carcass by an experienced mortician employed for the purpose.

After four months, it was still entire, but it could only be called a sad caricature of the graceful creature it was in life.

During the following night all but four of the remaining whales were hauled away to a rendering works. The last four were interred where they lay by means of bulldozers, at the instigation of county authorities. So, after less than a day and a half, there remained on the beach no evidence of this interesting event.

A number of theories as to the cause of the stranding have been put forth. Some press writers, perhaps with a view to exploiting the sensational, attributed it to "mass suicide," apparently unaware that lower animals do not deliberately destroy themselves. A more reasonable view is that the whales accidentally swam ashore in mad pursuit of their prey. But since I have learned firsthand that pilot whales feed preferably if not exclusively on squid, and since no squid of suitable size or numbers are to be found close along these shores, I am inclined to discount this theory. If, indeed, the pilot whales mate during their sojourn in southern waters, it is quite possible that panic broke loose as a result of competition between

males. In any case, fright seems to have been involved, and, judging from the reception given the four captive whales by the bottlenose dolphins in the oceanarium, it is also possible that these smaller but more agile and aggressive cetaceans, which abound in inshore waters here, were responsible.

On a coast that descends as gradually as our Atlantic seaboard, such stranding must result in death to most if not all the victims. As indicated in the foregoing, the end comes quickly as a result of drowning or overheating. As a matter of fact, if a cetacean should get back into the sea after several hours' exposure to the sun, it is quite likely that it will expire anyway. Some authorities, in recent press releases, have indicated that the pilot whales would probably die of suffocation due to collapse of the lungs under the animals' own weight. While this may be likely in the case of larger whalebone whales, in which the rib cage is much reduced, the thoracic skeleton of the dolphins is quite adequate to permit fairly normal breathing when stranded. Porpoises captured far off shore show no distress when carried to Marine Studios on the deck of the collecting boat, as long as their hides are kept moist. The pilot



▲ A NINE-FOOT FEMALE was hoisted into the truck on a second trip, but she did not survive the effects of exposure on the beach

➤ SPECIAL TACKLE for moving large fishes and marine mammals into the oceanarium is part of the routine equipment at Marine Studios





◀ WHEN THE OPPORTUNITY was taken to measure the stranded pilot whales, it was interesting to note how sensitive their skin was. Whenever it was touched, they closed their free eye



➤ THE YOUNG PILOT WHALE apparently loses some of its teeth through wear, and the adult has only five or six functional pairs in each jaw

whale is just a large porpoise or dolphin and has a very similar skeleton.

### *The Fate of the Four Captives*

It was inevitable that anyone who had the opportunity to observe these animals in the oceanarium over a period of time should compare them with the smaller dolphins. Indeed, the pilot whale is classified as a member of the dolphin family; but certain differences were immediately apparent. The pilot whales have far less of the sleekness and tapered streamlining that characterize the dolphins. They are more tadpole-shaped, the head and trunk being heavier and more definitely united. The eyes are set at the widest part of the body, in compensation for the fact that they cannot turn the head up and down and from side to side as do the dolphins. The eyes are also set at such an angle that, without rolling over, the pilot whale is unable to see beneath itself. The snout is short and, especially in older males, is overhung by an enlargement that

appears to be a less complicated counterpart of the spermaceti organ in the sperm whale.<sup>\*</sup> The shortness of the snout and the width of the head make for a relatively enormous gape when the mouth is open. Yet the jaw angle is quite narrow; fully two-thirds of the gape is taken up by great fleshy jowls. In contrast to the great number of teeth in the dolphin, adult pilot whales have no more than five or six pairs of functional teeth in either jaw. Younger ones have as many as eight or nine, but apparently several are lost by wear as they grow older. Once the animal has caught something with its teeth, which are limited to the front of the mouth, it handles it chiefly with its efficient tongue and jowls.

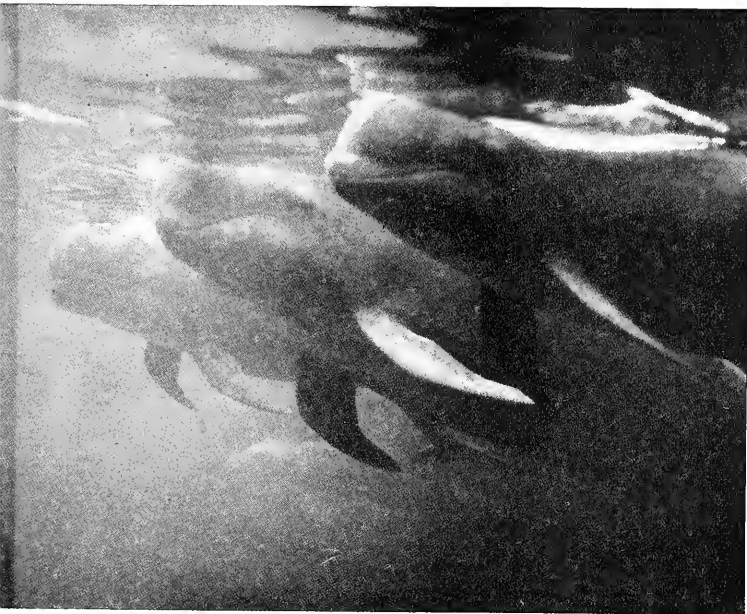
The pilot whale's flippers are quite attenuated, with a pronounced bend at the "knuckle," and are rather less movable than those of the dolphin. Like the dorsal fin,

<sup>\*</sup> Dissection has revealed that the pilot whale's spermaceti organ, like the narwhale's, is less specialized than that of the sperm whale. It is a pad of oil-filled connective tissue, which not only serves to buoy and cushion the head but also is intimately connected with closing the nasal passages when the whale dives.

they serve principally as stabilizers, but to some extent they are used as rudders as well. The tail is quite long and, particularly in the males, very much compressed laterally. The effect is much accentuated in old bulls by a pronounced crest on the upper edge. This crest makes identification of sex quite easy at a considerable distance. Other outstanding characteristics of the older males are the very high, hooked dorsal fin and a hump rising to the base of the fin from just aft of the blowhole. The spermaceti organ of the bull is particularly broad. In fact, whereas in the sperm whales the principal axis of the spermaceti organ viewed from the front is vertical, it is horizontal in the adult male pilot whale, producing a very different appearance. Young male pilot whales resemble the females in that they lack the hump and have shallower abdomens than the older males, but they do show the beginnings of the caudal crest. The spermaceti organ does not begin to protrude beyond the tip of the snout in young males until well after weaning. The blowhole is of the semicircular dolphin type, but its leftward displacement is very much more obvious.

In bright light the iris of the eye narrows down to a horizontal slit, but in dim light it is almost circular. This, coupled with the jet black color of the hide, broken only by a gray kedge-shaped mark on the breast, suggests that the pilot whale is primarily nocturnal. The activity of the captive whales supported this conclusion. In every respect, therefore, the anatomy of the pilot whale, as compared with the dolphin, seems to adapt it to the nocturnal pursuit of prey that is capable of some speed but not of quick turns. And the squid seems to meet these requirements. The dolphin, which feeds to a considerable extent on fishes, must be and is able to execute intricate maneuvers, which have not been observed in the more rigid and inflexible pilot whale.

The four whales exhibited a gregariousness not at all surprising in a species so strongly characterized by the herding instinct. They re-



▲ IN THE OCEANARIUM, the pilot whales kept so close together much of the time that their bodies touched



▲ NIGHTLY FEEDINGS accustomed the nocturnal pilot whale to the feeding platform. Visitors were entertained by the obvious pleasure he derived from being patted on his bulbous snout

▼ SOON AT EASE in their surroundings the pilot whales were not afraid of the diver with his food basket. They did not molest the smaller fishes in the tank but preferred squid, shipped to Marine Studios with some difficulty

mained together almost all the time, their bodies generally touching. They stayed at or near the surface almost continuously, only the smallest making shallow dives from time to time. It has long since been realized that pilot whales habitually rest in this position—with blowholes and the back and dorsal fin above the water surface, the rest below. The function of the spermaceti organ as a buoy is at once apparent. When the animal was resting, it used the flukes only enough to oppose the current in the tank.

The last one to be brought in—the one that was sunburned—failed rapidly, its tail dragging at steeper and steeper angles as it lost strength. None of the whales showed the slightest interest in the food fishes (blue runners and mullet) offered them or in the small porgies and grunts exhibited in the same tank. All had difficulty opening the eye that had been in contact with the beach.

The porpoises, which adopt a distrustful attitude toward any newcomer in the tank, even if it be a





newly-born porpoise, clearly resented the presence of the whales. At first, this animosity was made manifest only by the jaw-clapping with which male porpoises threaten one another. But on the third night, there was open hostility. A night attendant watched helplessly while the porpoises rammed and bit the whales. The whales were entirely on the defensive and sought only to avoid the attacks. One of the whales was pretty badly scratched, but the only serious outcome was the death of an infant male porpoise, born in the oceanarium less than six months previously. During the fight it was noted that when pressed, the pilot whale was capable of as much speed as either of the two species of dolphins exhibited in the tank. The fight lasted about an hour and a half, and no further incidents of the sort occurred.

Three of the pilot whales died within eight days after capture. The first one to go was the badly sunburned female. It survived scarcely 48 hours. At autopsy, the congested condition of the cerebral blood vessels confirmed the diagnosis of heat stroke. The second female died after seven days in captivity, and in this specimen as well, the post-mortem examination revealed signs of heat exhaustion. Porpoises have been known to live two weeks after suffering irreparable damage due to overheating. The third whale, one of the young males, died on the eighth day. A futile attempt to force-feed it with fishes and crabs was made on the day before. Handling necessitated by this maneuver probably hastened its end. All the while, we were making frantic attempts to secure squid, since it was apparent that the pilot whales would take no fish. A small amount of squid was received on the ninth day, and during the earlier hours of the following morning the last survivor had his first meal since before stranding.

#### *The Story of the Last Survivor*

During the first two weeks after he began feeding, the only surviving whale was restricted to a ration

of 20 pounds of squid a day. When an adequate supply—a whole carload, as a matter of fact—was secured, the ration was increased little by little until he was eating 40 pounds a day. Growth, which is extraordinarily rapid in cetaceans, was apparent in a short time. After 4 months it was estimated that he had put on from 100 to 200 pounds. He was quite fat and had developed a prominent paunch. He had increased in length about a foot.

At first, the squid had to be tossed to him as he swam about the tank. If they fell into the water directly ahead of him, he was apt not to see them and occasionally swam right over them. The spermaceti organ made it impossible for him to see anything within eighteen inches directly ahead. So the attendants soon learned to drop the food a little to one side and near enough to enable him to swerve and grasp it before it was snatched up by the more active fishes and dolphins. When the long-snouted dolphins were thus able to steal a squid, they quickly swallowed the morsel, but the bottlenose dolphins wanted only to play with it. They would toss it into the air again and again, eventually letting one of the numerous sheephead or triggerfish make off with the battered remains. When the whale became more active and aware of the consequences of this competition, he learned to throw his weight about in order to drive the fishes and turtles away.

Three whale feedings were scheduled for each 24 hours—in midmorning, midafternoon, and the early hours after midnight. It was during the night feeding that he was gradually conditioned to being fed from a small platform jutting over the water at the edge of the tank. In this stage of his training he would cruise about in tight circles, taking a single squid each time he passed the platform. The dolphins, turtles, and fishes also learned to come to the platform and for a while constituted something of a nuisance. It was found that the dolphins could be frightened away merely by waving a pole over the

water; but the turtles, exhibiting the mental sluggishness that always overtakes animals whose bodies are encased in stout armor, had literally to be shoved aside to enable the timid pilot whale to come in and get his meal. Presently, however, the youngster began to be aware of his own powers of strength and to share in the task of dispersing the rabble by ramming them with his spermaceti organ or by biting.

This phase of feeding soon gave way to a new, more satisfactory method. He eliminated the circling about and merely stayed alongside the platform, tail down, snout and jaws out, as the squid were placed, one by one, between his teeth. It was not until this was accomplished that the attendants were able to feed him fish. Since he had spurned blue runners and mullet when these were offered, 100 pounds or so of cold-storage herring were ordered from New England. The whale gave every indication of surprise when he found herring instead of squid in his mouth, but he downed them. He did not seem to digest the fish as well, but this may have been due to overfeeding. Herring constituted somewhat more solid fare than the soft, boneless cephalopods. So the diet of squid alone was renewed, and he thrived on it.

When feeding time came and the attendant approached the platform with the pail of squid, the whale usually arrived first. He moved away from arm's reach only to butt turtles out of the way, and it was evident that he derived pleasure from being patted on his bulbous spermaceti organ between morsels. When the pail was washed out, the whale glided away, already aware that this act signaled the end of the meal. He usually spent the next hour or so napping at the surface, in the characteristic sleeping position described earlier.

During the first two or three months of captivity, the whale slept chiefly at night, for periods of as much as two hours at a time. There was too much activity and noise in the oceanarium during the day. When he adjusted better to his surroundings, he could be seen

*Continued on page 331*



IT may flash like emerald gold one minute, then, as quickly, dim into invisibility. How could anything so entrancingly beautiful be scarcely mentioned in books on mosses? It is so little known that my first view of it brought the thrills of original discovery.

My path in search of this remarkable plant has bristled with interrogation and exclamation points. It was late in September when my lifelong friend, Miss Mary Lamprey, sent us, her callers, in search of this rare botanical treasure. For many years she had been harboring its growth in her barn cellar on a New Hampshire hillside. The sight fairly made us catch our breath. We saw on the hard-packed, cellar-bottom soil—between barrels and piles of boards, between a wagon body and a chopping block—aisles of dazzling, sequin-flecked, green-gold carpeting! We gazed in fascinated amazement. What magic brush had surpassed all previous achievements to produce these emerald-gold surfaces!

We stooped to scrape up a spoonful of the soil to look at it more closely. Instantly all its goblin-like luminosity faded out, and there appeared just plain black dirt! Absolutely nothing to clutch but well-trodden earth! Not a sprig of moss did we see! Not a particle of lichen-like growth met our eyes!

Straightening up, we looked about. There, again, on the granite underpinning, on and under a straddling sawhorse, were splashes of glittering green. These spots were not only a bright green; they glowed as if electric lights were behind them. We could scarcely believe our eyes, still less explain the wonderful spectacle.

Days passed. Several libraries were searched without finding mention of Luminous Moss in textbooks or encyclopedias. At the New Hampshire State Library, the late Dr. A. J. Grout's *Mosses With a Hand Lens* did give the most intriguing description of *Schistostega* that has yet been written by an American. He had been impressed as we had with the peculiarities of



## Adventures in search of a most remarkable botanical oddity

By ELLEN EMELINE WEBSTER

its luminosity and with its fleeting "temperament."

After noting both Dr. Grout's eulogy and the utter neglect of other students to list Luminous Moss, my curiosity was sufficiently aroused to write the botanical departments of several colleges. All the professors responded generously.

The aggregate of facts received was most valuable. Two professors sent me the quotation I had already copied from Dr. A. J. Grout's *Mosses With a Hand Lens*. The earlier specific name of *osmundaceae* had been changed, I was told, to *pennata*. And *Schistostega pennata* had been reported in New Hampshire from Lost River Gorge, Franconia and Dixville Notches, and Tuckerman's Ravine, but only one of these professors had actually seen it. All colored illustrations of mosses of any kind, so far published, were very old; even the uncolored ones used by Dr. Grout were more than century-old copies (about 1836) of *Bryologia Europaea*. And an ecological study of Luminous Moss, published in 1918, had been prepared by Viscount Yasumochi Toda at the Imperial University in Tokyo. I succeeded in obtaining this from the Congressional Library at Washington, D. C., and copied it almost in its entirety.

The marvelous research of Toda thrilled me to the finger tips. But I ran into nomenclature that was

as unintelligible as the "Mene, Mene, Tekel, Upharsin" that floored King Belshazzar. The bryological terms "Chromatophore, Chloroplastid, Cytoplasm, Prothallium, Pteridophyta, Protonema, Sporangium, and Archegonia" needed a Daniel for interpreter. Without attempting to pose as a Daniel and with the use of as few jaw-breaking names as possible, I give my version of the growth of *Schistostega*.

Although Luminous Moss, because of its oddities, is placed in a family by itself, it is a moss, and its development follows more or less that of all mosses. It has a stem, leaves, and roots. The anemic-looking plant, which Toda refers to as a "shoot," is about an eighth of an inch high, with sickly, bilious-green leaves. Like all mosses, it is flowerless, but at a certain season it sends up tiny stalks, each stalk bearing aloft a capsule (sporangium), which contains the spores that serve as seeds. When the spores are "ripe," the capsule opens and the spores are scattered.

After hours of concentration over various authors, the growth of a spore into a moss plant has become somewhat, though not altogether, clear to my mind. The spore is as a speck of dust that has to be magnified about 500 times to appear as large as a grain of pearl tapioca. Yet that speck is filled with a colorless sap in which are grains, or



Photograph by Elbert D. Currier

chloroplasts, that contain chlorophyll (green coloring matter) with starch, sugar, and whatnot. These pigment cells in the Luminous Moss change shape according to the amount of humidity, temperature, direction, and intensity of light.

Our spore of Luminous Moss, let us say, has found a spot that is moist without being soppy. If the atmosphere has a humidity of over 90 per cent and a temperature between 60.8 and 77 degrees F., with a dim light—too dim for other mosses to grow—the spore will, within a month's time, send out a threadlike tissue called "protonema." Each spore seems to possess a personality that grows without rhyme or reason, producing different shapes, sizes, contents, and positions. It reminds me of Ezekiel's vision in which he saw "as it were, a wheel in the middle of a wheel . . . and their rings full of eyes." To call the pigment cells "eyes" is appropriate because eyes may glitter.

The thread, elongated from the spore, starts borning within its tube a series of cells which, like beads, may string along in a row or, like grapes, cluster into a bunch. Certain of these cells may start a real moss plant, called a "shoot"; or filamentous thread-sized tubes may be produced, or a chain of lens-shaped cells, and so on, changing direction, ramifying, but always with the specks of chloroplast suspended in the cell fluid.

This protonema is mighty important. It isn't actually the moss plant, nor can it even be called the *root* to a moss plant. It is a thread-like runner *connecting* moss plants. The dictionary defines it as "a filamentous structure developed from a spore, on which the leafy plant arises as a lateral shoot." This filamentous structure, until magnified, is finer than a strand from a spider's spinneret, but it is tougher than the moss plant proper. It excels the moss plant in its ability to withstand heat, cold, drought, flood, variation of light, and poor nutrition. The luminous plant may live at a dying rate or lie dormant for years and then revive when normal living conditions are restored. During a long drought, the plant shrivels and its cells store up oil for holding its vitality, instead of the starch that is needed in the cells of the protonema to give out the angelic light. And it is for an explanation of this light that our curiosity has been whetted into active research.

Dismiss all thought of the "shoot" with its leaves, roots, and capsule-headed stalks, for no part of them is luminous. Concentrate on the protonema and, what is more, concentrate only on its bean-shaped cells. There are spherical cells in the protonema, but they do not perform the trick of lighting up any bed of moss.

One authority has likened the bean-shaped cell that contains the

◀ "OLDFIELDS," the picturesque New Hampshire farm where Miss Mary Lamprey found the rare moss growing. Despite the unique fascination it holds for botanist and layman alike, few have ever seen it

▼ WITHIN this opening to the cellar of the barn the Luminous Moss glistens like a sequin-flecked carpeting of green gold. If you pick it up, it at once loses all its refulgence



Photograph by Dr. Charles J. Lyon

pigment granules (chloroplastids) of green coloring matter to a bi-convex lens having an upper and a lower wall. Split this bean cell open and its outer walls would show the curve of a parabola. The chloroplastids must be concentrated in the *basal* area of this paraboloidal wall, not scattered hit-or-miss fashion on the upper as well as the lower half. Moreover, these bean-shaped cells must lie at right angles to the ray of light that acts the part of torch. If the ray travels *along* the optical axis, it is so refracted that it hits the pigment granules, and the consequent decomposition of carbon dioxide produces a "glitter." It seems that if the source of light is moved, the chromatophores change their position in the direction of the new light in about a week.

The light enters as white light; it emerges as a luminous green. Scientists state emphatically that this is not what is known as phosphorescent light but something altogether different, yet nonetheless startling in effect. And startling is none too emphatic a word. Grass is green; many mosses are vividly green, but they do not *glow*. They do not shine and glitter like cats' eyes in the dark. You come away from a bed of Luminous Moss really hugging yourself because of the



▲ THE PLANT enlarged and in natural size, from a drawing by Ethel Hutchinson

novel sight. As the gleaming luster from a ruby, a diamond, or an emerald attracts and holds our attention by its consummate beauty, so *Schistostega*, by its luminosity, must always surpass all other mosses because of its individual radiance—a radiance that comes from *reflected*, never from *direct*, light. Always, in order to see it, the observer must stand with his back to the opening that furnishes the light. Only when you are directly between the tiny parabolic reflectors and the source of light will the moss shine. But use care not to shut off *all* the source of light. Also change position to receive reflections from various angles in order to discover the complete areas of the sheets of goblin gold to be found growing in that particular cave or cellar.

Which of our American bryologists is going to write another chapter to the life story of *Schistostega* that will be outstanding in significance? Already three whom it was my privilege to bring in contact with one another are to be credited with beginnings: Miss Mary Lamprey, our generous hostess; Mrs. Ethel Hutchinson of Canaan, N. H., who did noteworthy research and produced slides for the microscope; and Dr. C. J. Lyon of Dartmouth College, who was the first to produce kodachromes of *Schistostega*.

Mrs. Hutchinson, a person of cyclonic enthusiasm, has been studying with our most eminent bryologists and collecting New Hampshire mosses for ten years but had failed in that time to find *Schistostega*. Learning the location of Miss Lamprey's surprisingly pro-



▲ ONE LEAF and part of the stem of the Luminous Moss, enlarged many times, showing the leaf cells. Neither the leaf nor any other part of the true plant gives off the light. It comes from the protonema—the primary threadlike substance from which the plants themselves grow

fuse growth of Luminous Moss, she let no moss grow on the soles of her shoes until she had visited this barn cellar several times. She stood on her head in the mud to make observations and found that the tiny mosses were in fruitage. She collected soil and plants, and, following my notes from Toda, she made transplanting and actually succeeded in starting growths of leaves and witnessing the gleam of the protonema from her own Luminous Moss, but the plants did not survive the winter.

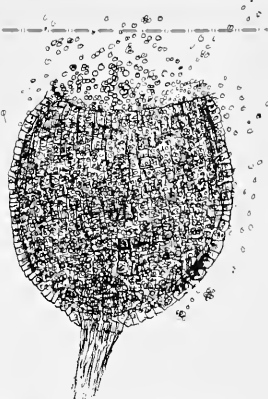
That is by no means all she has accomplished. She has separated all the different parts of the plant and made a series of slides for the microscope. She has sent a score or more packages of the moss, which she names as "the most beautiful thing of the sort in all nature," to various bryologists, and has held correspondence with members of the Sullivant Moss Society.

Five of Dr. Lyon's films with descriptive paragraphs were sent to Dr. H. S. Conard for presentation on the Chicago program of the Sullivant Moss Society in December, 1947. These bryologists considered this display truly wonderful.

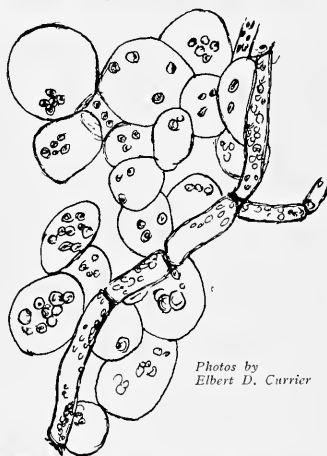
Buoyed up by these thrilling developments, I determined in 1948 to be on hand when *Schistostega*



ONE CELL SHOWING CHLOROPHYLL GRAINS



▲ THE CAPSULE with its spores bursting forth in a cloud under pressure of the cover glass on the microscope slide. This, like the other drawings, were made by Miss Hutchinson with a camera lucida from the actual slides. Magnification 440 times



Photos by Elbert D. Currier

▲ THE PROTONEMA with the light-bearing cells, from a specimen mounted in glycerine and enlarged 440 times

had lighted her lamps. I was rewarded by an even greater display than that of 1947. This moss with "beaming green . . . burnished through every fiber into fitful brightness" had spread as carpeting over the length and breadth of the cellar, from within a foot of the entrance to the opposite wall; yet should you carry a handful of the scintillating soil, an illuminated foundation stone, or a glowing board into the bright sunlight for a studied view, not a vestige of a glimmer would reward your efforts! Truly a mystery plant!

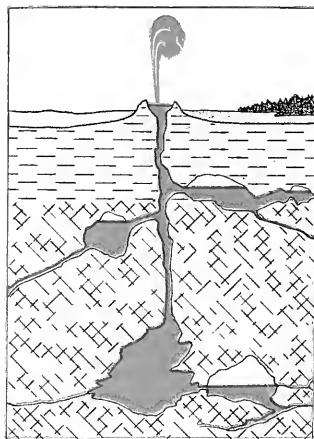
# Thermal



▲ OLD FAITHFUL's four-minute display every sixty-five minutes helps to draw about a million visitors to the Park each year. But there are more than 10,000 distinct hot-water features in Yellowstone, only about 500 of which have been named. In 1920, 99 per cent of the visitors reached the Park by train; 7 years later 99 per cent were arriving in their own cars.

JOHN COLTER trapped in the Yellowstone area as early as 1807, but his accounts were called impossible. And when the famous storyteller Jim Bridger began his explorations in 1830, his exaggerations further convinced people that it was a myth. Not until 1869 did expeditions begin to bring back accurate and convincing knowledge of the world's most fantastic display of thermal wonders.

The Washburn-Langford-Doan Expedition of 1870 reached the Upper Geyser Basin on a clear September day. Coming out of dense woods, the travelers were dazzled by the glorious eruption of a towering column of water and steam. With a roar, the fountain spread like a magic tree, growing lacy



▲ DEEP in the geyser, water under pressure from the weight of the water above produces superheated steam. Bubbles of this steam, rising in the tube, suddenly convert additional quantities of water to steam, accelerating the eruption. Steam chambers that lack outlet above the water level also doubtless play a part

◀ GROTTO GEYSER erupts every two to eight hours, but it is perhaps more famous for its cone. The colorful convolutions show how elaborate the cone of a geyser can become



# Wonders of Yellowstone

Since the first rumors of "Colter's Hell" fell on incredulous ears about a century and a half ago, millions of visitors have thrilled to Yellowstone's matchless array of natural marvels

By JOYCE and JOSEF MUENCH

branches that blossomed in the sunlight.

Since that summer, when they spoke of it as "Old Faithful, the Guardian of the Valley," this best loved of all Yellowstone's surprising features is estimated to have erupted half a million times, every 65 minutes or so, day and night and in every season.

Without its regularity, Old Faithful would not have become the

symbol it is. Its rhythmic dependability is what captures people's interest and curiosity.

"It's almost time for Old Faithful!"

A ranger takes his position at a safe distance, and a camera appears in almost every pair of hands.

There is a rumble and hissing of steam, and the tremendous roar of rising water hardly drowns out the gasps of delight that have come to be part of its performance.

Why does Old Faithful erupt at such regular intervals? The force behind the eruption is, of course, the pressure of steam. Its suddenness is due to the fact that conditions in the tube beneath the cone prevent large volumes of water from reaching the boiling point until a given moment.

Water that is under pressure will not turn into steam at the normal 212 degrees F. Greater heat is nec-

▼ **OPAL TERRACES.** One of the most rapidly depositing formations at Mammoth Hot Springs is Opal Terrace, at the foot of Capitol Hill. Its delicate form and pastel shades make it a thing of beauty

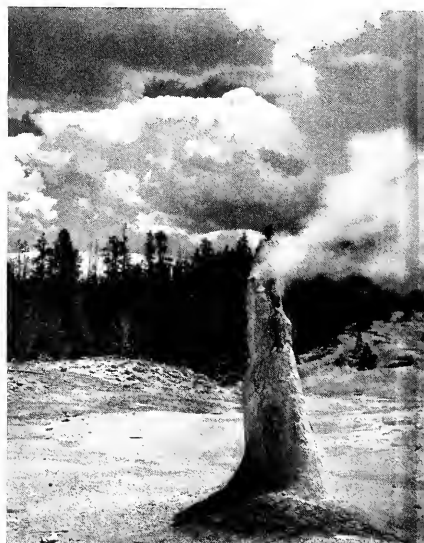






◀ **LIBERTY CAP** was built by a hot spring rather than a geyser. Material gradually deposited by the water formed layer upon layer of travertine, until a height of 37 feet was reached. The spring no longer flows, but a tiny plant is struggling for existence at the top

▼ **MONUMENT GEYSER** has a slender, columnar form, taller than a man. It erupts almost continuously, but most visitors never see it because its secluded valley can only be reached on foot



essary. The weight of the water in the tube of the geyser makes the pressure higher near the bottom of the tube than at the surface. It is not ordinarily possible to heat water hotter than its boiling point (212° F. at sea level); it simply boils and goes off into the air as steam. But the water deep in a geyser, being under pressure, exceeds the normal boiling point of water. The hot rocks with which it is in contact gradually raise its temperature beyond this point, and the narrowness of the tube above prevents the heat from being distributed upward to where the pressure is less. Eventually, however, the water at the bottom reaches its own boiling point, and bubbles of superheated steam are sent violently upward through the tube. Suddenly water in various parts of the tube, already near the critical

point, produces steam. Water is forced violently out at the top, and this further reduces the weight of the column. Conditions thus combine to hasten the conversion of large quantities of water into steam, and the geyser "blows its top."

It seems likely that steam chambers like those shown in the diagram on page 312 also contribute to the sudden violence with which this and other geysers erupt. If steam is quickly generated in such a chamber and cannot escape without forcing a quantity of water out, a fairly long eruption might result from a relatively small cavity.

If a large piece of turf is thrown into a geyser, the eruption may be hastened. The turf plugs the tube and thus causes the lower water to heat up more rapidly. Soap, especially, is believed to hasten a geyser's eruption. The Chinaman's

Spring has become famous for an accidental eruption that is said to have been provoked when a Chinese laundryman was washing his clothes in it. His soap or a piece of clothing dropped down in, and the geyser threw his wash some 40 feet into the air. The intentional use of soap or other material for this purpose is frowned upon by park authorities.

Fears that Old Faithful may be "losing its pep" are entirely unjustified, according to Dr. Philip F. Fix, who has recently made a study of its modern performance in comparison with all the earlier records. The famous geyser erupts just as often and plays to the same height as it did in 1870, according to Dr. Fix's studies, published in the April



► PUNCH BOWL SPRING is delightfully colored, and it bubbles constantly in a particularly attractive setting

▼ ANGEL TERRACE provides a wintry scene in summer. The spring has sheathed the ground with gleaming deposits, killing the trees that were caught in its path



▼ FISHING CONE. When the level of Yellowstone Lake is low, it is possible to walk over to this cone of hot water rising from the cold basin of the lake. Fishing is not permitted from the cone, but old stories tell how one could catch fish in the cold water and cook them a few inches away in the hot.

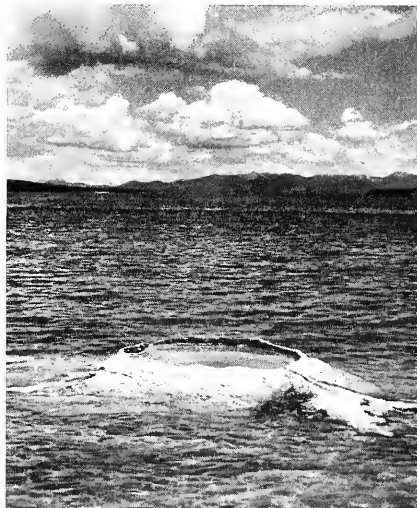
Geysers and hot springs alone do not make Yellowstone an incomparable spot for the student of nature. Remarkable opportunities to observe wildlife and a wide assortment of geologic oddities, from petrified forests to entrancing gorges, place it high among the world's true wonderlands

issue of the *American Journal of Science*. It also apparently discharges the same volume of water as it did in 1870.

Old Faithful is not always as regular as popular reputation implies. In 1948, it erupted twice only 33 minutes apart, and on one occasion in 1941 it waited 91 minutes. But these are the recorded extremes, and in *average* interval, it is amazingly dependable. Precise records taken 70 years apart show only a difference of about a second in the average interval of 65 minutes, 6 and a fraction seconds.

The quantity of water discharged each time by Old Faithful has often been exaggerated, Dr. Fix explains. A figure commonly given is 750,000 gallons, but fairly accurate gauging 20 years ago estimated the quantity to be between 10,000 and 12,000 gallons. The height of the eruption is usually about 120 to 150 feet.

Much additional information of interest on geysers can be found in *Hot Springs of the Yellowstone National Park*, by E. T. Allen and Arthur L. Day. Publication 166 of the Carnegie Institution of Washington, 1935.





▲ ADULT. The golden-eyed lacewing fly, about three-quarters of an inch long, has beady, golden eyes and pale green, lacy wings. During the day, it

patrols the foliage of trees and shrubs in search of plant lice and other small insects. In the evening, it flutters to the nearest light

## GOLDEN-EYED

# Lacewing Fly

THIS little fairy-winged insect (*Chrysopa oculata*), found throughout most parts of the country, is generally seen in the evening fluttering among low-growing shrubbery. When viewed at close range it is as beautiful as its name suggests, but when crushed, it is liable to give off a sickening odor of which a skunk could well be proud.

The golden-eyed lacewing fly is of particular interest because of the unusual manner in which the female places her eggs. Her young, known as aphid lions, are so hungry when they hatch that the first one out will eat up all the eggs containing the others if it happens to find them. In view of this tendency, it is fortunate that mother lacewing secretes a series of stiff,

A strange cycle of insect life that almost anyone can observe

By GEORGE A. SMITH

silklike stalks and attaches an egg to the end of each one. Then when a hungry aphid lion hatches, it crawls down from its egg stalk and goes away in search of something else to eat.

Aphid lions are of great economic importance because they destroy countless numbers of plant lice, as well as many other injurious sap-sucking insects. During its growing

period of about 10 days, one aphid lion will devour as many as 300 or 400 plant lice. As it moves over a plant infested with lice, it leaves a graveyard of empty skins behind. So greedy and fearless is this little dragon-shaped larva that it will attack almost anything, from one of its own brothers to the tough skin of a human hand placed in its pathway.

► EGGS. The female lacewing fly places her eggs on a series of stiff, silklike stalks. There the first of her greedy offspring to hatch will not eat up all the eggs containing the others



◄ LARVA. As soon as the larva, known as an aphid lion, hatches, it climbs down from its cradle and goes away in search of juicy plant lice. Picking up the lice one by one in its needle-pointed jaws, it drains them of juices



► PUPA. After satisfying its appetite, the aphid lion curls up on the underside of a leaf and spins a spherical, silken cocoon around itself. In about sixteen days, the adult lacewing fly emerges by cutting an opening in the cocoon

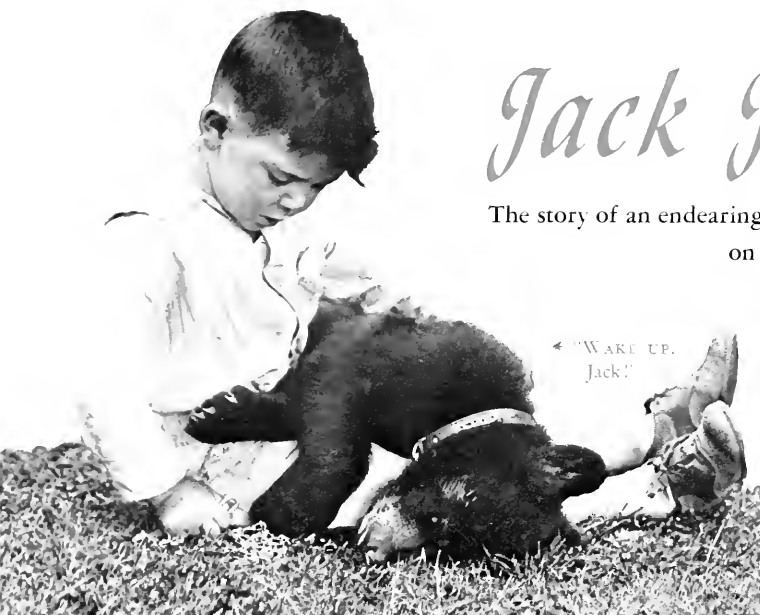


# Jack Johnson

The story of an endearing rebel

on the campus of an eastern college

By LELAND GRIGGS



▼ THIS LITTLE MAID cried when he kissed her, but think if he were your size



JACK JOHNSON, a worthy namesake of a famous American pugilist, entered Dartmouth College directly from the backwoods of Maine. His career was not unlike that of many a college boy: he wasted his time in outside activities, such as out-of-town trips, picnics, and athletics. He flunked out at the end of his freshman year, and he has never returned to a class reunion.

There is a strange myth abroad in the north country that little bears are really not "born" at all. When I asked an old river warden in Newfoundland where they did come from, he told me that they were created by the devil without either father or mother. Jack certainly had plenty of the devil in him; but there is no doubt that he was born in a perfectly natural way while his mother was asleep in her winter den. At birth, if he was a normal bear cub, he was a tiny helpless thing weighing less than a pound. When he came to me in early spring he was about the size of a small house cat.

At first he was a lean, sickly, and very homesick cub, requiring more care than I could give him. I put him out to board with a kindly old lady who had always shown much interest in my pets. She took him into her home and gave him the best of motherly care. By day he was tied to a leg of her kitchen stove, and by night he slept in a box in a warm corner behind the stove. Every time he cried, she took him in her arms, patted him, and gave him a saucer of milk. For exercise she took him to walk twice a day, up and down the village street. Under this treat-



▲ His daily bath

ment he soon became fat and happy. When I took him back, he was in the pink of condition.

A student of animal behavior once remarked that a kitten is a shapeless mass of protoplasm until it molds itself into a cat by exercise, especially by play. Jack acted on this theory; he spent most of his waking hours in vigorous play. His first playmate was a puppy that lived next door; but this arrangement was not very satisfactory, for the puppy played one game and Jack another. Jack wanted to box and hug—a bear's normal method of defense—while the puppy tried to learn the art of hamstringing and throttling. Each, of course, unbeknown to himself, was preparing for his own special part in the struggle for existence. Jack, puzzled and irritated by the puppy's style

of play, once spied a cat asleep on the porch. Perhaps a cat would know how to box; but in this he was very much mistaken. When he cautiously sneaked up on puss and gave her a smart uppercut to the jaw, she flew into a rage and scratched his face. Poor Jack, who outweighed the cat by several pounds, came whimpering back to me with a bloody nose. He never took on a second cat.

After the small boys and girls of the village discovered Jack, he had plenty of company every day, ready for any sort of play. But he was only a little cub, quickly tiring of a roughhouse, often falling asleep right in the middle of a game. Sometimes the boys would drag him around the lawn by a hind leg without waking him—but I am not so sure he was as sound asleep

as he appeared to be. Once a little fellow of about five years old was trying to rouse him, when the bear suddenly came to, grabbed the kid by the heels, and slammed him down on his face. This boy was usually very well behaved and never used any swear words; but that was just too much. He came up to me sobbing and stuttering, "Doc, I am sick of this damn foolishness." It was a long time before I ventured to tell the kid's mother of this shocking incident.

Jack was an affectionate little scamp who loved to hug and kiss his playmates. On one occasion, after sitting quietly for a few minutes in the lap of a little maid, he suddenly gave her such a hug and smack as drove her into the house bawling. No wonder! He always gave a rugged kiss, and if he did not like the taste he followed it with a smart box on the ears.

Jack liked to visit the boys' camps near Hanover. Needless to say, he was always welcome, especially at swimming time. Although he was a clumsy little cub, he was as good as the rest in the water. If, after a race or two and some snapping at bare heels, that old tired feeling came over him and he crawled out on the shore for a nap, he was usually tossed right in again. The rougher the play the better; Jack was no quitter at that kind of game. He stayed with the boys until a counselor blew the "all out" whistle.

Jack also made many friends among the older folks. Everybody knew him by name. One day on my way home to dinner we were passing a workman who had just opened his lunch box. The man offered the bear a ham sandwich, which made a mere mouthful; then a second sandwich followed the first, and a third and a fourth until the sandwiches were all gone. Next Jack grabbed the mince pie out of the man's hand. Even the coffee disappeared to the last drop. I offered the poor hungry workman a half dollar for a dinner at a lunch cart, but he refused saying he had never enjoyed a meal more.

As Jack grew older he began to



▲ HE would box your ears one minute . . .

. . . AND kiss you the next

lose friends. One such person was a kind-hearted old lady who lived in the next street. Every time we passed her door she came out with a cookie or a piece of candy for the "little dear," as she called him. But when she offered him a drink of milk in a small glass, too narrow for his big muzzle, he proceeded to knock the glass, milk and all, into the middle of the street, and, not content with that show of temper, he tore off about a square yard of the lady's pink skirt—and that square yard was about all there was to that particular skirt. Jack brought me the skirt; but since neither Jack nor I had any use for such a garment, I folded it up and left it on the lawn. She never called him "little dear" again. Every time after that day when she saw the bear coming, she ran into the house, slamming and locking the door behind her.

Jack also managed to get in wrong with the rector of the church that I attended and for whom I acted as chauffeur. This good man was traveling all over the county visiting the sick and conducting missions—"saving souls" as I called it. I believed that we could save more souls if we took Jack along

as an added attraction in drawing a crowd of sinners. We tried the experiment, and all went well until Jack performed a little trick that the college boys had taught him—untying knots, especially shoestrings. When my rector found that he could not tie his shoestrings as fast as the bear could untie them, he insisted that we leave the bear at home, as he thought it undignified for the rector of St. Thomas Church to ride through the main street of the village with his feet over the windshield of the car. And, furthermore, he said that there was really no truth whatever in my ridiculous statement that with the help of a bear we were saving "four or five souls to the gallon of gas."

One by one Jack's old friends dropped away; but the college boys stayed by him to the end. They taught him many tricks to which



I never gave official approval. Every bear, of course, knows how to hug; but Jack was taught to turn an ordinary bear's hug into a hard, low football tackle around the ankles. He sometimes dropped his victim right in his tracks.

One morning as I was on my way to class, a freshman happened to be strolling across the campus. His hands in his pockets, his little green cap on the back of his head, never dreaming of impending danger. Somebody called out to me, "Let's see if Jack will take him on." It looked like a long chase, but I gave the signal, "Go get him Jack," and away he went. He made a splendid tackle and dropped the poor freshman flat on his face. There was great applause from the spectators as Jack galloped back to me, much pleased with his success. I afterwards apologized to the freshman, who admitted that, al-



though he had heard that Dartmouth was a wild place, he was greatly surprised to be attacked by a bear right in the middle of the campus.

This little trick of a football tackle once led to a near tragedy. As Jack was starting to tackle a student, a finely dressed gentleman came around the corner by the Hanover Inn just in time to get the tackle meant for another. The poor gentleman was considerably disturbed. Even after the students had explained that it was really an honor to meet the famous Jack Johnson, he turned away in anger, muttering to himself that this was to be his last trip to Dartmouth College.

Jack was invited to join the Dartmouth Outing Club and became one of its most active members. He attended all the strawberry shortcake feeds that were held that summer. Since he was too tired and lazy to tramp very far, he was carried in a big pack basket by one of the heelers of the Club. He thoroughly enjoyed these trips, standing up with his paws on the edge of the basket, viewing the landscape and now and then taking a nip out of the heeler's neck. As soon as he arrived at an Outing Club cabin, he stretched himself out on the porch in the warm sun and slept there until the sun went down, when he dragged his bones into the cabin and sprawled out by the fireplace. Nobody disturbed him until supper was over. Since it was a rule of the Club that every member must do his share of the work, Jack had to get busy. He could not be trusted to hull strawberries, but he made a very good dish-washer. As soon as the feast was ended, some heeler hauled him up on the table. He made the circle of the great dining table licking every dish perfectly clean, doing a much better job than the heelers ever did with their dish mops and towels. Everything disappeared — cream, potato salad, coffee, lemonade, and on one occasion even a bouquet of violets. When the work was over, he jumped down by the fire again. With a deep bearish sigh of con-

tent he fell asleep, his black belly blown up like a football.

Jack had many other invitations, one of which caused me much anxiety. It came from William Jewett Tucker, ex-president of Dartmouth College. Dr. Tucker had long since retired, but, although an invalid and confined to his room, he never lost his keen interest in all things that pertained to Dartmouth. The college men of my time looked upon him as a sort of saint and holy man, and although I knew that Jack Johnson had little respect for God, man, or the devil, we accepted the invitation to make a friendly call. I gave the bear a bath, fluffed up his fine glossy black fur, put a big blue ribbon around his neck, and off we went. Mrs. Tucker met us at the door and led us into the sickroom where the old, white-haired man was lying on his couch. Jack behaved very well for a bear. He walked up to the couch, stood on his hind legs with one paw on the edge of the couch, and offered the other paw for a handshake. With this little ceremony over, he climbed into a chair and proceeded to rock back and forth until his eye caught sight of the doily on the back of the chair. It was tied with four bowknots! He promptly untied the knots one after another until the doily was free; then he sat there waving it about in great delight. But I knew he would soon be ready for more mischief and suspected that he might be casting an eye on Mrs. Tucker's shoestrings. I bade my hosts good-by, and we departed. I knew by Dr. Tucker's smiles and chuckles

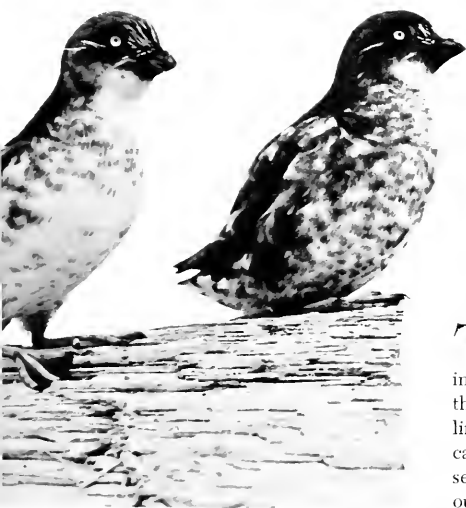
that our visit had been successful. As a freshman I had sat in the college chapel and gazed in awe and reverence at the president's inspired face, never dreaming that some day I should see him shaking hands with a bear.

In the fall, as the frosty mornings appeared, Jack began to make preparations for his long winter sleep. His appetite was boundless; he ate everything that came his way, from ice cream to June bugs. While he was laying on his reserve fat, he must have consumed several bushels of carrots as well as a large supply of sweet potatoes and dog biscuit. He worked every day stuffing leaves and rubbish into his den until he had a good soft, warm bed. One morning in early December after a big snowstorm, he failed to appear, and I shoveled a huge pile of snow all over his den. I never saw hide nor hair of him until March, when he reappeared apparently none the worse for his long nap.

As the summer wore on I decided that it was high time for Jack and me to part. He rarely showed any temper, but he was getting rough and hard to handle. An old friend of mine from Springfield, Vermont, had asked for him and had promised to be very good to him. I summoned this new master to come and take Jack Johnson away. One evening the man drove up in an old model T. Jack jumped in beside him on the front seat, and they drove down the street and around the corner. Jack never said good-by nor even looked back. I never saw his homely black face again.

▼ DOORMAT at an outing club cabin





# Choochkies

By KARL W. KENYON

U. S. Fish and Wildlife Service

Photographs by the author

When the Least Auklets abandon their rocky nests for less tempestuous seas, the islanders of the north know that the somber grip of winter will soon take hold

THE misty north wind ruffles their feathers as they perch in scolding, chirping bands along the wave-tossed boulder crests that line Pribilof beaches. The Aleuts call them Choochkies, which to me seems much more appropriate than our prosaic Least Auklet. No larger

than a robin without a tail, they were the first birds to catch my eye as we approached St. Paul Island's foggy cliffs. Like swarms of giant bees, flock after flock sped on whirring wings close over the Bering's dull waters and then vanished in the mist.

▲ THE CHOOCHKIE'S FACE is decorated with short whisker-like plumes. Their color pattern is variable, as shown here. In winter, the mottled breast becomes white

► MUCH ROCK-ROLLING is needed to find these birds deep in the crevices among the tumbled boulders of the Pribilof beaches





▲ AS THEY SWEEP IN over the cliffs toward the inland nesting grounds, many Least Auklets are caught in nets held aloft by Aleut hunters

Beneath the weather-rounded boulders of the beach, where the fur seals gather to bear their young and carry on their noisy courtship, or among the moss- and lichen-covered rocks of inland island slopes, these diminutive members of the auk family appear equally at home. They choose to place their single white egg in a deep recess beneath the tumbled boulders or in some crevice of the basaltic cliffs and talus slopes. When they choose the rocks of a seal rookery as a nest site, they apparently care little about the bleating and slapping of flippers raising a steady din above their heads. Fearless of the bickering swarms of seals, the choochkies dodge in among their noisy neighbors, alight near their home crevice, snatch a quick glance at the seals, then vanish among the rocks, chittering and muttering.

Their home-coming, though, is not always peaceful. Once as I watched the constantly moving sea-side panorama of seals and birds, I saw a choochkie attempting to land on a rock that lay almost under the nose of a harassed cow seal. The little bird made several attempts to land, but the seal invariably snapped at it, just as a dog might snap at a buzzing fly. The bird was not easily discouraged. It circled repeatedly out over the water, then back toward its chosen rock. Suddenly the seal became involved with a near-by animal in an



▲ THE LEAST AUKLET feeds on shrimplike crustaceans of the sea. Webbed feet are aided by wing motions underwater, so that the bird may be said to fly both above and below the surface

◀ A DOWNY LEAST AUKLET just taken from its burrow beneath the cobbles of a Pribilof beach by a native islander, Alex Galanin

argument over her rookery space, and in the ensuing confusion the choochkie deftly swerved to a landing and slipped out of sight. Apparently, seals have little taste for birds and seldom concern themselves with their tiny neighbors.

Choochies are birds of the North Pacific and Bering Sea and are seldom seen, even in winter, as far south as the coast of Washington. Unimportant as they may seem to us, they are a happy sign of coming spring to the winter-bound Aleutian and Pribilof Islanders. When the choochkies arrive, the natives know that the grip of winter has broken. Even while drifted snow lies packed deep in the little gullies and among the rocks, the choochkies hurtle over the beaches and cliffs, headed toward favored nesting spots.

During the long winter months hunting is poor on the islands, and the springtime choochkies are a welcome table luxury. As they arrive the Aleuts set out to catch them, much as the Eskimos of Greenland gather the doves that live in similar spots along the shores of the North Atlantic. Armed with oversized dip nets, the Aleut men and boys hide along cliff edges where the choochkies pass. Heavy-bodied and small of wing, the birds maneuver poorly on short notice. As a flock approaches, nets shoot up, and an unlucky bird or two is gathered from midair. Unlike the Eskimos, the Aleuts prefer their birds cooked rather than raw.

I once watched several of the younger boys catching choochkies without nets. They hid among the rocks just beyond the breaking surf, where flocks habitually passed. As the birds flew in low overhead, the boys swung at them with short sticks. Surprisingly enough, they knocked down several. Choochies are inquisitive, and the boys have discovered a trick that brings additional flocks into range. Crouching among the rocks, almost out of sight, the hunter holds up a dead choochkie. As a flock approaches he shakes the dead bird rapidly, making it appear to flutter. His other hand is ready with the stick, and as the flock veers to investigate,

a skillfully aimed swing may bring down another tasty morsel for dinner.

By the time egg laying begins, choochkie hunting is over and the birds continue their summer nesting season unmolested by human hunters. This was not true in years past. One day on St. Paul I was talking to Cabe Stepetin, a native of the Pribilofs and a senior member of the community. He mentioned that when he was a boy the people gathered the eggs of the choochkies as well as the birds. He went on to say: "Pretty soon the big colonies near the village began to get smaller, so we have not taken the eggs for many years. When I was a boy it was no trouble to go out and gather a whole canful of choochkie eggs in a morning." Since the eggs are no longer taken for food, the birds apparently hold their own very well. Such numbers of them swarm about the islands that the small percentage now taken for food apparently has no effect on the population.

Of the two Pribilof islands, St. George attracts more nesting choochkies than St. Paul. But on St. George, the largest colonies are nearly a mile from the sea along broken, rocky slopes and hillsides, whereas on St. Paul they nest only among the boulders of the beach.

The Pribilof blue fox is numerous on both islands and apparently makes the nesting grounds somewhat hazardous for unwary birds. One morning I hiked across one of these nesting colonies while groups of choochkies scolded from every lichen-covered boulder. A little way ahead a blue fox scampered nimbly from among the rocks and, after staring boldly in my direction, took up an escort position about 50 yards ahead of me. He trotted over the rough terrain at just my walking speed, watching the birds and causing them to dart into the air or disappear among the rocks as he approached. Suddenly an unwary bird popped from a crevice. It was headed toward the fox and seemed unable to gain altitude rapidly. Hardly breaking his step, the fox threw his muzzle up just as the

bird passed and snatched it from full flight. With little more than a faint flutter, it hung lifeless in his jaws. Such episodes must frequently be repeated, yet both choochkies and foxes have probably been on the islands for centuries and the large bird population continues.

Choochies gather their living from beneath the sea, where, like others of the auk family, they use their wings to help in swimming. Unhampered by table manners, they approach their nesting grounds and waiting chicks with not only a mouthful but a throatful, as well. Frequently, in this overstuffed condition, they sit along the tops of the rocks near their homes to chirp and enjoy the company of their neighbors. While sitting thus, it is a common sight to see the small crustaceans that they have recently gathered oozing from the edges of their bills. When they feel that something may be lost, they jerk their heads upward, making several quick gulping motions. In this way, they are apparently able to keep their own meal and the one reserved for their young settled in place. A chick that an Aleut boy had dug from beneath the rocks was stuffed so full of the little pink, shrimplike crustaceans that they constantly protruded from the corners of its bill.

Early to arrive on the Pribilofs, the choochkies are also one of the first birds to leave as summer closes. In early August I hiked along the rocky beaches where a few weeks before choochkie notes sounded from beneath every rock, but I found that none remained. Unlike other island nesting sea birds, they leave well in advance of stormy fall weather, to pass the winter at sea from the Aleutians and the Commander Islands south as far as Japan. November's winds were heaping up stormy seas when I last saw choochkies. We had headed south and were leaving the tempestuous Bering Sea to enter the sheltered Aleutian passes. Little flocks of ten to twenty choochkies burst from the dark sea ahead or dived from sight when our dipping bow tossed forth a deluge of spray.



# CLOTHES MOTHS

By C. H. CURRAN

Curator, Department of Insects and Spiders,  
American Museum of Natural History



AMNH photo

▲ A FEMALE CLOTHES MOTH laying eggs. She herself is a harmless creature, completely without appetite—but she can produce 100 or more ravenous larvae

How to know them when you see them, and how to protect your furs and fabrics from their ravages

CLOTHES moths are generally considered to be Public Enemy No. 1 by the American housewife. Her husband may have the same idea, and with good cause. There is scarcely a family that has not suffered from the depredations of these tiny but voracious creatures, and once they become established in a household they are difficult to dislodge. The size of the adult moth is about twice that of a large grain of rice. Their live weight is about equal to the rice, and it would require five or more dead specimens, from which the moisture has evaporated, to equal the weight of a lusty living specimen.

The three kinds of moths that attack our clothes originated in Europe, and they have probably been associated with man from the time he began using fur for clothing. Unused or discarded pieces of fur about his primitive dwellings would have provided ideal breeding places for the moths, just as fur coats that are not in constant use do today. Primitive man probably paid no at-

tention to the tiny yellowish or grayish moths that rested on fur pieces. He was very different from the housewife of today, who becomes alarmed at the sight of any small moth in any part of the house and rushes to kill it. Quite often the offending moth is a harmless creature that has flown in through the window, attracted by the lights in the home. More often the moth may be one of those that feed on cereals, nuts, or dried fruits—insects that originate in the kitchen rather than in the clothes closet, chest of drawers, or storage trunk. Almost 90 per cent of the moths brought to the American Museum by alarmed housewives belong in this latter category; less than 10 per cent are clothes moths.

It is very doubtful if householders see five per cent of the clothes moths in their home. Like almost all moths, the adults are naturally nocturnal and fly only at night unless disturbed; but they may fly about a room on dark days or when the blinds are drawn. Unlike most moths, they are not attracted to

light but always prefer shadows and dark places. They have become so accustomed to darkness that they are able to survive in sunshine for only a few hours. Thus when a clothes moth flits about a lighted room in order to find new materials upon which to lay its eggs, it will usually hug the shadows. And it is most adept at escaping from clapping hands and a vigorously wielded fly swatter. For a moth, it can run extremely fast and can quickly sidle out of sight behind some piece of furniture. If the moth you are chasing lands on a bright area and makes no attempt to reach the shadows, it is almost surely *not* a clothes moth.

Unfortunately, the killing of an adult clothes moth is not of much importance in preventing damage. The only possible advantage would be in killing a female that still had most of her hundred or more eggs to lay. It is not the winged form that eats your clothing. The adult moth eats nothing. During the caterpillar stage, clothes moths eat enough to last the rest of their lives. Enough nourishment is stored by the caterpillar to enable it to build its cocoon and change to the pupal stage, the process whereby all the elements in the body break

down and ultimately reassemble in the form of a moth whose only duty is to propagate its kind.

There is some question as to which of the clothes moths is the most destructive. This is not because the larvae of any particular species eat more than another kind but because one species predominates in some parts of the country or in some parts of a state. An inexperienced person has difficulty in recognizing the two common forms. The Webbing Clothes Moth is the only one that has come to my attention, with one single exception, yet many entomologists state that the Case-bearing Clothes Moth is the most common! Not a single case-bearer has been brought to the American Museum in the past 20 years, and in all the buildings I have examined, the pest has always been the webbing one.

The webbing clothes moth is known as *Tineola biselliella*, and the adult is readily recognized when one becomes familiar with it. It is creamy in color, with a brick-red head, pointed wings, and a

length of approximately a quarter of an inch. Specimens brought in for identification are usually badly mangled from having been crushed. Sufficient experience enables one to identify them, though with most small moths a nearly perfect specimen is usually necessary.

The *Tineola* larva is quite characteristic because it spins silk wherever it goes. As it feeds, it more or less covers itself with a silken canopy; and if it wanders from the tunnel it has eaten in your clothing or bedding, it leaves a silken trail, possibly to enable it to return to its original grounds. As a general rule, the caterpillar is able to find sufficient food for its full growth within an inch or less of the place where it starts feeding; but if it finds the food there untasty, it will travel, nibbling as it goes (and leaving a silken trail), until it finds a spot to its liking. It is *Tineola's* habit of building an extra-heavy canopy over its principal feeding place that causes it to be confused with the case-bearing species.

The larva of *Tinea pellionella* builds and carries its own house around with it. Externally, the case looks like the material upon which the caterpillar is feeding, because it is composed of short, chewed-off pieces of that material fastened together with silk. If the material should be a plaid, the pattern would be lost because there would be a blend of the various colors. Because the caterpillar adds to its house as it grows, many who have reared the moth to study its life history have amused themselves by feeding the larvae different colored wools at different times so as to produce cases of intriguing patterns.

Regardless of how the outside of the case may look, the inside always bears a stout lining of smooth, pure white silk. Since the case is built as soon as the newly born larva begins to feed, it must be frequently enlarged, and the caterpillar has evolved a most efficient manner of doing this. It is the same procedure that a tailor follows when he has to let out trousers to accommodate the expanding midriff of a gentleman who is becoming portly. The offending trousers are ripped from the top at the seams, and a long, narrow, V-shaped enlargement is made. The case-building larva has no seam to cut, since the case is solidly woven silk. But it has no real worry. It merely chews a narrow line in the case from the front end to a little behind the middle, forces the resulting slit well open, and fills the space with new lining. Then it repeats the process on the opposite side. One end of the house having now been enlarged, the caterpillar turns around and goes through the same procedure at the other end. Obviously, this process would soon result in a silken, wool-covered case that would be much constricted in the middle. But the caterpillar takes care of this by slitting the case in the middle, spreading it, covering it on the outside with pieces of its foodstuff, and lining the inside with new soft silk.

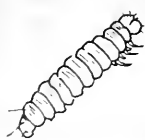
The case-bearing clothes moth produces only one generation each

▼ THE CLOTHES MOTH destroys only when it is a caterpillar, but it's in the housewife's interest to kill it in every stage. A turning point in man's age-old warfare against this insect can be gained through wise use of modern remedies

## LIFE CYCLE OF THE CLOTHES MOTH

The eggs of the clothes moth are laid singly in places where the caterpillars will find food. Preferred places are stained or soiled parts of clothing and other woollens or lint-filled cracks in floors and walls. Dry cleaning protects articles.

When the larva, or caterpillar, is removed from its case or tunnel, it looks like this. It is only during the caterpillar stage that materials valued by householders are destroyed.



The webbing clothes moth is creamy in color, with a reddish head. The case-bearing clothes moth is dull cream, with dark spots on the wings. The moth itself is entirely harmless, since it takes no food of any kind. But its presence is a warning of potential damage.

The silken cocoon of the clothes moth contains the pupa in a sarcophagus-like case. Inside this the essential organs of the caterpillar break down and reassemble to produce the flying insect.





year. When the larva has become full-grown in the fall, it walks off in its case and seeks a place in which to spend the winter. It may crawl from carpets or clothing upon which it has fed to the underside of a shelf or ceiling or into any crevice that will provide protection. In such a place it remains in a torpid condition until the following spring, when it changes to a pupa. About three weeks later the adult moth emerges. If it is a female, she finds a mate, then goes about the essential business of locating suitable material upon which to lay her eggs. The adult moth is dull-cream in color, with a number of dark spots on the front wings and paler, unspotted hind wings.

The third species, *Tricophaga tapetzella*, is not too common in America, but where it occurs, it causes fully as much destruction as the other kinds. It usually shows a strong preference for furs and woolens, in which it builds silk-lined tunnels that enable it to move at will from one feeding place to another. It pupates within a tunnel. Perhaps its chief interest lies in the fact that it is known to breed in the pellets of indigestible bones and fur regurgitated by owls. The eggs are laid in the pellets during the warm days of spring, and the larvae grow to maturity by fall. This moth is supposed to be the only one of our clothes moths that is able to survive northern winters out of doors. Its outdoor life history has

not been thoroughly studied in North America, and we cannot state positively whether it can survive if there is not a heavy protective covering of snow. Actually, the moths that lay eggs in owl pellets may have passed the winter in infested buildings.

According to all the textbooks, clothes moths feed only upon animal products, and the list is a rather long one. If we wish to make it short, we may say in a very general way that the larvae feed upon fur (hair) or feathers, which may be classified as modified hairs. They also feed upon casein and milk products. They are not supposed to feed upon plant products or silk, but one of the heaviest infestations I have seen occurred in cheesecloth—and, strangely enough, woolen goods in the same home were not attacked.

This particular infestation occurred in Canada at a time when I was running the first test of calcium cyanide as a fumigant for insects in flour mills. An uncle informed me that his house was full of clothes moths and asked me to investigate, hoping, I am sure, that I would fumigate his home. I ex-

amined the house. There were numerous clothes moths flying about, since the blinds had been kept down, but I could find no trace of moth damage in carpets or other woolen goods. The attic had more moths than any other part of the house, yet I could find no woolens stored there. The only thing in the attic, other than wooden furniture, was a huge box of cheesecloth that had been used as insect screening during the summer. Naturally, I was not interested in that, and it was only after I had left the attic that I decided to take a look at it. When I opened the box, my eyes popped. Clothes moths were swarming over the cheesecloth by the hundreds, and a casual examination showed that it was interwoven with the webs of the webbing clothes moth. I quickly closed the top and gave instructions to have the whole thing taken to the back yard and burned. This was done, and the infestation disappeared. In this case the cheesecloth had been used two seasons before and had not been washed before storing. It probably had entrapped thousands of small insects and, in spots, had become stained by grease. It provided an ideal breeding place for the moths, and

AMNH photo



▲ THE LARVAE of the clothes moth

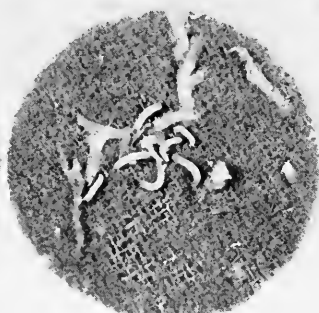
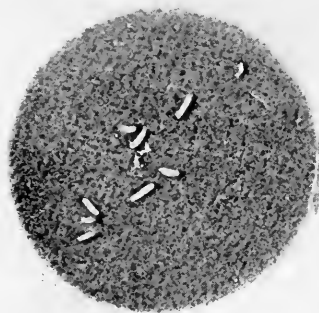


Textile Research Institute Inc.

▲ IN TYPICAL EATING POSITION: the lowered head of the larva, with lower jaw pushed into the nap. The creature often finds all the food for its growth within an inch of where it starts feeding

◀ TREATED FABRIC unharmed (left); untreated fabric badly damaged (right)

Photo courtesy Du Pont Co.





*International News Photo*

▲ A PERFECTLY CLEAN coat in an airtight bag will stay moth-free, but it's safer to rely on cold storage. Larvae are inactive below 40 degrees F.

they made the most of the opportunity.

A chief source of infestation is soundproofing material. At one time, felt was commonly used for this purpose. It is still used for insulating water and heating pipes and as a cushion in hangers in the flooring. Once these felts become infested, the moths will come out wherever they can find an opening, and the whole building is exposed to their attack. How the moths find their way into the felt is a mystery. They breed there by the millions; those that find their way out attack carpets, clothing, and furniture.

Where clothes moths are observed flying about in numbers that are really alarming—ten or more a day—the chief source of supply may

be some rather small, unnoticed object. In one apartment a thorough examination of carpets and closets revealed only two or three larvae. Attention finally focused on a stuffed owl that stared wisely from the top of a tall bookcase. When its feathers were ruffled, moths swarmed from it, and beneath what seemed to be outward complacency there was a labyrinth of silken tunnels and threads.

At a summer home in central New York State a moose head, which for 20 years had gazed mournfully from above the fireplace, was the cause of an annual infestation in a New York apartment many miles away. The moths swarmed from the head and laid their eggs upon blankets and

woolen clothes that hung unused during the warm summer months. Blankets brought back from the country were found to be infested each year.

For several years, clothes moths appeared in considerable numbers in my office at the Museum. I was not worried because there was nothing in the office that could be damaged. Finally I became curious and made a thorough search. In the back of a coat closet, tucked in a pair of high boots, were the remains of a pair of woolen socks that had been stored a few years before in anticipation of another field trip. Later, the original source of this infestation was found, quite fittingly, in the Lepidoptera room, where a quantity of green felt had been stored, years before, in an unused insect cabinet.

We must not get the idea that all infestations occur in unusual places. Far from it. In a New York City apartment on Park Avenue, where the carpets were deep and springy, the moths flew about freely behind curtains drawn to prevent the sunlight from fading the colors, but very few caterpillars were found about the edges of the rugs. However, in the lush carpeting that covered the stairways, the story was different: dozens of larvae were found on each step and riser. From these almost continuously darkened areas, the moths had spread through the whole apartment, and if left undisturbed they would have eventually infested every square foot of carpeting.

It is generally believed that clothes moths cannot withstand freezing temperatures and that storage of woolen clothing and furs outside during the winter will prevent damage. At one time I shared this belief, but I have long been completely disillusioned. When I returned to Canada after the First World War, I brought back almost no souvenirs, but I did want to preserve my uniform as a reminder of the days I had spent with a famous Scottish regiment. To be sure that nothing would happen to it, I placed it in a trunk with other possessions and put this out on an

unheated, enclosed sleeping porch. In winter the temperature was frequently colder than 20 degrees F. below zero for days at a time, and I was certain that everything was safe. It was two or, perhaps, three years before I had occasion to open the trunk, and the sight that met my eyes was anything but heartening. Clothes moths were swarming in the trunk, and my prized kilts were white with webbing and more thoroughly riddled than if subjected to several rounds of buckshot from a twelve-gauge gun.

In those early days of insect control the methods of preventing damage from clothes moths were crude and not too efficient. It may seem foolish to refer to the early 1920's as "early days," but when the conditions of those times are analyzed, one realizes the wonderful advances that have been made during the last 20 years. At that time paradichlorbenzol, commonly known as dichloricide, was unheard of as an insecticide; it was a waste product of industry. Its first use in America was for the protection of museum collections from insect pests, about 1924. Its use as a protection against clothes moths came several years later, and it was not until the early 1930's that it gained its rightful popularity.

Previously, the common procedure against clothes moths had been to pack woolsens and furs in moth balls. Camphor was the favorite substance, and I can well remember wearing my winter clothing or my dress suit for several days with the odor of camphor contaminating the pure, fresh air. Of course, my mother hung out all the unentombed clothing in the bright sun to dissipate the telltale odor, but somehow it would cling, and when one came from outside into a warm room, there would be tilting of noses and knowing looks. Then, too, it was embarrassing to have someone remark: "Well, I see you're coming out of the moth balls."

Later came naphthalene balls and crystals. They were much less odorous and their stench less lasting. Also, they were evidently less efficient. It is possible that camphor

did kill most clothes moth caterpillars when used in sufficient quantity, but naphthalene kills very few. The best it does is to prevent moths from laying eggs on stored materials.

Early in the present century there developed a belief that cedar chests would prevent damage by clothes moths. The idea probably originated from the fact that grandmother, or great-grandmother, always stored the warm articles used in winter in a cedar chest, and they were never damaged. In the days of grandmother and great-grandmother, cedar was a common wood. There were large trees that yielded fine lumber, and chests made from them had a pleasant odor. We know that some insects do not like certain odors, but it has never been proved that the clothes moth does not like cedar. It might like the odor just as much as we do. Even if it doesn't, cedar chests lose their cedary smell after a few years. The fable about the protective powers of the cedar chest may be explained by the fact that houses in grandmother's day were poorly heated. Often, during the night, the water in the pitcher on the washstand in the bedroom would freeze over. Many times have I broken the ice and doused my shivering face in those cool, health-giving waters. In the cold houses of those days the clothes moths could only indulge in feeding for three or four months of the year, and they did not develop rapidly as they do now in buildings having a temperature of sixty or over almost every day in the year.

Grandmother had one method of protection that will do a good job today. Several times—two to four—during the summer, she would take all the blankets, winter coats, and furs outside and hang them in the bright sunlight to air. She didn't know, of course, that sunlight meant death to the clothes moth caterpillars. Maybe she thought that airing just helped preserve the clothes; but regardless of that, she was employing a wonderful method of clothes moth control. She would also have the carpets and rugs taken

outside in spring and autumn and given "a good beating." That was to get the dust and dirt out of them: it got any unwary clothes moth larvae out, too.

Dichloricide ushered in a new era of clothes moth control. For the first time, we had a handy material that would not only keep clothes moths away but would actually kill the larvae. True, it is a slow killer, and even in a sealed trunk it might take a week or more to destroy the pests. It was used, and still is, in various ways. A half pound or more of the crystals, depending upon the size of the area to be protected, may be placed in drawers, trunks, or clothes closets. In the latter it should be placed on the highest shelf in a shallow container, such as a saucer, or hung from the ceiling in a cheesecloth bag. The gas given off is heavier than air, and if a deep container is used, the gas is unable to escape over the sides. Crystals are many times more efficient than "cakes" or pellets. To protect carpets during the summer, they may be lightly sprinkled with dichloricide crystals, then rolled, wrapped, and sealed in heavy paper.

When you use your vacuum cleaner in reverse and blow the fumes of dichloricide over your rugs or carpets, you may be doing some good. However, since the material is a very slow killer it is obvious that such casual treatment is of no lasting value. In my tests I have found that larvae may remain active for at least four days when their woolen foodstuff is covered with crystals; then, when removed to fresh air, they develop normally.

One of the simplest ways to prevent damage to clothing, blankets, and carpets is to place them in cold storage. At temperatures below 40 degrees F., the larvae are wholly inactive, and young larvae are unable to survive two or three months at this temperature. Full-grown larvae, to be sure, may survive such treatment for as much as six months, but in the spring, when you are usually thinking of cold storage, all the larvae are young. Clothing that has been in frequent

use does not harbor moths, but it should not be stored at home without first being dry-cleaned, because soiled clothing attracts moths much more than clean clothing. Dry-cleaning kills both eggs and larvae. But you'd better not trust your fur coat to home storage. Better put it in cold storage.

Both of the above procedures are merely emergency measures. To get rid of the pests, you must destroy them where they have become entrenched. After we had moved into our present home, we learned that one closet had a reputation of being heavily infested with clothes moths. Our neighbors told us after

we had discovered it ourselves. Every spring and all during the summer an occasional clothes moth and sometimes a half dozen at a time would be seen dancing merrily over the clothing. They had taken up their abode in the lint and dirt that filled the cracks in the floor, shelves, and walls, and deep down in these cracks they were protected by the lint from the fumes of dichloride and from heavy spraying with rotenone, pyrethrum, and DDT. Each spring, like guerrillas, they would sally forth from their stronghold, and almost inevitably some article of winter clothing would be damaged. Had the closet

been kept closed and sealed for several weeks, it is possible that the pests might have been eliminated, but it was in almost daily use.

The moths were driven out of the closet by the use of a special lamp shade heavily impregnated with DDT. The shade was placed over a 50-watt lamp and the light turned on for several days. Later, the lamp was lighted only a few hours a week. The idea seemed fantastic. It did not seem possible that such a simple device could do what really drastic measures failed to accomplish. Three things combined to produce the result. Clothes moths do not like light, and they need a

## The Bottle Palm

By WALTER HENRICKS HODGE



L. H. Bailey photo

▲ A BULGING MIDRIFF makes the middle-aged Bottle Palm the butt of various jokes but provides the Cubans with a number of useful objects

ON the sandy savannas of extreme western Cuba and on the near-by Isle of Pines grows the Bottle (or Barrel or Belly) Palm, *Colpothrinax Wrightii*, one of the most curious of the great group of palms.

Just what is the purpose of the curious swelling on the trunk is unknown. Possibly it represents a region for the storage of reserve foods. Certain it is that the strange tumid growth does not ordinarily appear until the tree matures, for young trees usually lack the bulge.

Since palms, like most monocotyledons, lack the important cambium layer that causes diameter growth in most trees, the sudden swelling in middle age must be explained as a subsequent swelling of cells already formed. The Cubans, not without humor and seeing a resemblance between their tree and the surplus *avoiropois* that sometimes appears among humans, have nicknamed it the *barrigona*—literally the “potbelly” tree.\* Moreover, they put it to strange uses. Hollowed out, the swollen sections of trunk occasionally are made into canoes, crude barrels, watering troughs for domestic beasts, or even crude beehives.

\* This is not to be confused with the *barriguda* or “barrel-bellied” tree of Brazil (*Cataniella arborea* Schumann), described in the May 1946 issue of *NATURAL HISTORY*.

certain amount of moisture. The light was unpleasant enough, but the heat also dried the air. In addition, and more important, the heat from the light caused some of the DDT to volatilize and spread through the closet. Air currents were also set up, and fine crystals were carried from the shade and settled on walls, floor, and clothing. For three years now the clothes closet has been safe, and so have others in the house which have received the same treatment.

Not all treatments are so simple. When the infestation is general, drastic procedures are necessary. Where carpets are infested and where the cracks in the floor serve as a continuous source of infestation, there is need of special measures. Spray materials, such as DDT or chlordane, must be forced under high pressure into carpets and into the cracks in the floor. Where insulation is the source, materials must

be used that will result in mothproofing. Fumigation with cyanide is useless. This extremely dangerous gas is lighter than air, and even an abnormally heavy dosage will not penetrate carpets or lint. It is work for an entomologist who knows his job.

Cyanide fumigation has a place in moth control, but I do not think it belongs in the home. Pieces of furniture, such as mattresses, rugs, chairs, and couches, may be sent out for treatment in vacuum fumigation chambers, but even this method is not wholly approved because unless moths are completely eliminated in the dwelling, reinfestation may occur. However, it does a fast job, and other control measures may be undertaken while the furnishings are away.

Furniture and mattresses are treated nowadays with some of the new insecticides in a highly volatile, fireproof carrier. Long needles are

injected into the packing of the infested article, and the spray forced in under very high pressure. Sufficient gases disseminate through the packing to kill moth larvae, and a protective residue is left.

We repeat that one very simple precaution should always be taken. Clothing and other woolen goods should be dry-cleaned before being stored, to remove any stains or grease: the larvae love contaminated places, and if they find none, the article of clothing may escape damage.

How much damage does the clothes moth do? Well, it probably destroys a half-million suits of clothes and other garments each year, with a value in excess of \$25,000,000. Add to this another \$10,000,000 or more for cold storage and an additional \$10,000,00 for protective chemicals and you get some idea why it pays to keep the clothes moth out of your home.

## THE PILOT WHALE AT MARINELAND *Continued from page 308*

sleeping at the surface at almost any hour of the day.

There was no doubt in the minds of his captors that at first the young whale was lonely. This was to be expected in a species as gregarious as the pilot whale. For a long time he confined his activities to the south half of the tank, and this was perhaps erroneously interpreted as an effort to place as much distance as possible between himself and the porpoises, which spent much of their time in the north half. Eventually it was realized that this was only due to the fact that the nocturnal whale sought the shade of the southern wall, while the dolphins were more at home in the sunnier portion.

Little by little the whale became accustomed to intimate association with the other animals. Gradually the dolphins came to accept him as a member of the community, and rarely one or more of them would entice him into a game of chase. Usually when they approached in a spirit of playful pugnacity, he threw himself on his back, the better to follow their movements



with his eyes. At the end of a series of spirited dashes about the tank, in which the participants (including the whale) sometimes threw themselves out of the water, the dolphins retired to the sunny side and the whale to the shadow side, to rest. The whale squealed through his blowhole just as the dolphins did when excited. One day the whale discovered the jets through which fresh sea water was forced into the tanks. These powerful streams of water coming from the bottom of the tank held a sort of fascination for both the whale and the dolphins. All of them seemed to derive some sort of

pleasure from thrusting their heads directly into the powerful stream. It is probable that the torrent exerted a caressing effect on their extremely sensitive hides, and anything that may produce such a feeling is eagerly sought by all the captive cetaceans.

Thus, when an attendant scrubbed the walls of the tank with a scrubbing brush on a pole, the whale came to him to be scrubbed also. Whale and dolphins alike spent many of their waking hours rubbing themselves on the hapless loggerhead and green turtles. The whale, lacking companionship of his own kind overdid this to the extent that he suffered abrasions, particularly to his eyelids, from the claws and sharp beaks of the turtles.

One of the most outstanding play characteristics of porpoises is that of mouthing and tossing into the air dead fishes, pebbles, feathers, and other objects encountered in the tank. So it was not at all surprising when the whale began to take notice of such objects. He had not taken to playing catch but had been observed snatching floating objects from the drain vortex in the

center of the tank. He carried them a short distance away, let them go, and followed them back into the whirlpool to take them again and again.

Unhappily, the brief saga of the world's only captive pilot whale was brought to an abrupt close on July 6, almost nine months to the day after his capture. In April, he had received a setback when the bull porpoises, mad with mating fever,

had buffeted him mercilessly with their snouts and tails. Although two of the latter were replaced by females, the rough treatment was resumed late in June. About ten days before he died, a decided loss in appetite was noted. It was not until an autopsy was performed that the cause of this was determined. The right ramus of his lower jaw was fractured. Half-healed rib fractures, probably dating to the

trouble in April, were also found. Yet he did not starve to death, since, in addition to his blubber, thick layers of adipose tissue were found. His passing was a great loss to Marine Studios not only because he constituted a truly unique exhibit but also because he had become, through his eager response to kindness and good care, endeared to all who were concerned with his welfare.

## LETTERS *Continued from page 290*

You'll recall in my article about the swans in Alberta (*NATURAL HISTORY*, Oct., 1948) I mentioned a pair breeding on the ranch of one Joe Tomshak, near Grande Prairie. They should have had eggs this coming year.

The female picked a fight with a moving automobile about a month ago and was killed. Too bad!

DUANE FEATHERSTONHAUGH.  
Duanesburg, N. Y.

### *Beggar's Bowl*

SIRS:

The article you published in the January issue on the largest seed in the world—the Seychelles nut—was most interesting.

Soon after I read the article, I noticed what appeared to be a half section of a Seychelles nut on the arm of a native beggar in the bazaar of Kuwait town, near the head of the Persian Gulf. He was utilizing it as a begging bowl. Later, while visiting in the home of Lt. Colonel and Mrs. H. R. P. Dickson, I asked Mrs. Dickson if she had ever seen one of

these bowls and if she could tell me something about its origin. From her collection of Middle East curios she produced a specimen of a half section of Seychelles nut which had been made into a beggar's bowl. I took the accompanying two photographs of it.

Colonel and Mrs. Dickson have resided in Kuwait for over twenty years. He is a retired British Political Agent. Mrs. Dickson has studied the plant and animal life of this area for many years and is considered the local authority on it.

At my request, Mrs. Dickson wrote



the following interesting account regarding the Seychelles nut:

"I have spent many years in the Persian Gulf and Iraq, and up to some years ago these half nut-shells were carried by every fakir and beggar from Persia and Afghanistan who wandered through the cities of the Middle East. They are still used today but are not seen so often. In them food and money are collected. Two rings were screwed into the upper overhanging portion, and a chain was attached, through which the beggar put his arm. The inside was completely scooped out, leaving only the wrinkled, veined, and ebony-hard shell. On the outside, usually only a portion of the rough husk was left; the rest was cut away and was polished.

"Among some of the tribes of the lower Euphrates in southern Iraq, this half shell is used today as a drinking cup in the large guest chambers that are made of reeds from the marshes. It is dipped into the large earthenware water jars (*hub*) which stand just inside the entrance of every one of these dark, cool guest or council chambers. The belief is widespread that no matter how sick or ill a person is who may drink from this bowl, the infection cannot be transmitted to anyone drinking after him.

"I have had one of these bowls for many years. It was presented to me by the Sheikh of the Fatla tribe, Sheikh Mizhir bin Faraam, who lived near Um al Barur, Middle Euphrates, on the edge of the marshes.

"It was indeed a high honor to be presented with one of these valued bowls. The Sheikh himself did not know what the bowl was made from or from where it came. He called it *Kashkul*, which is the name by which it is known in these parts.

"Here in Kuwait, the sea captains and sailors who trade between Kuwait, Basrah, India, Zanzibar, and Arabia will tell you that these shells are found washed up on the coast of Goa—Portuguese India. They believe that they are some kind of great oyster shell from the bottom of the sea. Every household here many years ago used one of these shells to drink from. They were of various sizes, some small



and some large, and they usually had the overhanging top removed. There are still some in use in the Shia Mosques here. They are attached to the wooden stand below the water jars by a small chain hanging through a ring on the bowl.

"Some years ago, when some officers of the Royal Navy who were visiting this port saw the bowl hanging in my drawing room, they told me that it was made from the half shell of a very large nut which grew in the Seychelles group of islands."

I thought these extra details might be of interest to some of your readers.

WILLIAM C. BUIE.

Kuwait, Ahmadi, Persian Gulf

### "Thanks"

Sirs:

My sincere compliments to you and to your staff on the entire June, 1949, issue of *NATURAL HISTORY Magazine*.

My personal compliments are of little moment. But in all walks of life I hear many expressions of appreciation from persons of varied interests and occupations, to whom your magazine brings a new appreciation and understanding of the world around them and the interrelations of This with That.

I should like to learn that others also are writing you of their understanding and appreciation of the fine work that the Museum is doing. Your magazine is the only inkling most of us have of what really is going forward.

"MUCH INTERESTED."

New Jersey

### "Stern" Words

Sirs:

As a subscriber to your very excellent magazine, which my family and I enjoy immeasurably, I am taking the liberty of calling your attention to an error in the excellent article, "The Spin of the Sea," by N. J. Berrill.

My daughter and I took the courses at Columbia on oceanography, and Dr. Berrill's article was intensely interesting until I reached page 272, third column, in which Dr. Berrill states:

"At one time a U. S. Coast Guard Cutter lying across the cold wall found the sea temperature at the bow to be 34 degrees and at the stem 56 degrees F."

Someone should have told Dr. Berrill that the bow and the stem are one and the same part of a vessel. The probabilities are that most of your subscribers picked this up, but I just wanted to make sure that you have done so.

EUGENE A. SCHMITT.

New York, N. Y.

Thanks to Mr. Schmitt's kindly comment regarding this "slip that passed in the night," *NATURAL HISTORY Magazine* will in future try



## What About Sex Among Animals?

By EDWARD DEMBITZ

With some species of animals, it takes an expert to tell the male from the female. With others, the distinction between the sexes is quite marked, not only in the reproductive organs but in major physical characteristics, habits, and their relationship to man.

The questions below test your awareness of these latter differences. Indicate your opinion on each question by circling either the M (male), the F (female), or the B (both male and female). Then turn to page 334 for the correct answers. A score of twelve right is well above average.

1. Which crickets chirp? . . . . . M F B
2. Which African elephants have tusks? . . . . . M F B
3. Which nightingales sing? . . . . . M F B
4. Which mosquitos bite humans? . . . . . M F B
5. Which diamond-back terrapins are marketed for food? M F B
6. Which spiders spin webs? . . . . . M F B
7. Which lions have manes? . . . . . M F B
8. Which katydids say "Katy-did"? . . . . . M F B
9. Which kangaroos have pouches? . . . . . M F B
10. Which caribou bear antlers? . . . . . M F B
11. Which horseflies bite horses? . . . . . M F B
12. Which lyrebirds have lyrelike tails? . . . . . M F B
13. Which musk deer yield musk? . . . . . M F B
14. Which honeybees are the "workers"? . . . . . M F B
15. Which fireflies emit light? . . . . . M F B
16. Which fur seals are taken for their fur? . . . . . M F B

**Correct answers on page 334**

to remember whether it is coming or going.—Ed.

### Minus Tail Feathers

Sirs:

At the feeding station in my window, one chickadee was definitely *boss*. In fact, he was dubbed Hitler, so emphatically did he dictate. This bird could not be mistaken for any other, not only because of his manners but because he had a dark streak like a scar across his pale breast.

In early March, Hitler suddenly appeared one day without a tail. In the blustery winds and the snow, he looked about as ridiculous as a man in shorts at a Christmas party.

In about two weeks a beautiful new tail was fully grown—but alas, in a short

time only one feather of that remained, and in two more days he was again tail-less.

Now he is sporting tail Number 3 and is as belligerent as ever. Is this a customary procedure in the molting season? If not molting, could he have lost *all* those feathers in fights?

MURIEL THOMSON.

Kitchener, Ontario

The following comments are offered by Dr. John T. Zimmer of the American Museum's Bird Department:

Miss Thomson's account of the chickadee's tail is interesting, although the experience is not uncommon among birds.

There is every possibility that the bird's tail became frozen to its perch during one of the cold nights, so that it was pulled out when the bird attempted

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to depart in the morning. Such occurrences are not at all rare. A fight with another bird or a near escape from a predatory cat could have been the cause, but considering the weather at the time and its repetition shortly thereafter, I believe the first explanation is the correct one.

When the bird is healthy, feathers lost by accident are promptly replaced, at least up to a certain point. The limitations have not been determined for the vast majority of birds. In fowl, it has been reported that the regular body plumage can only be replaced three times between periods of regular molt, but the primary flight feathers of the wing are less restricted. It would not be surprising to find the tail feathers also less limited than the body feathers since, like the primaries,

they are of much more importance in the bird's existence. Nevertheless, they probably have a definite limit of exhaustion. Comparative figures on such details would make an interesting study.

It has been found that when the capabilities of a feather follicle, which is the cavity from which the feather grows, have been exhausted by repeated activities of this sort between molts, normal growth of a new feather nevertheless takes place at the next molting season. If the successive feathers are pulled out as soon as they grow, necessitating unbroken continuity in replacement, some breakdown of pigmentation appears to occur that does not happen when there is an appreciable interval. Full details of this and other interesting circumstances have yet to be established.

**BOOKS** *Continued from page 295*

same one twice (pp. 13 and 566). Many of the photographs are uncredited and were evidently taken by Miss Pitt herself; others are by such talented bird photographers as Eric Hosking and G. K. Yeates. *Birds in Britain* opens with a passage from *The Canterbury Tales* and closes to the stately rhythms of *Paradise Lost*. All in all, enough poetry about birds is quoted to fill a fair-sized anthology.

This is an informative, if somewhat diffuse, volume. Every bird student will find much of interest in its pages, even though he is neither a beginner nor a resident of the British Isles.

DEAN AMADON.

**THE TWELVE SEASONS**  
 - - - by Joseph Wood Krutch  
 William Sloan Associates, \$3.00  
 188 pp.

**F**OR the author, the year begins more properly in April, and his "perpetual calendar for the country" begins and ends with Spring Peepers, as a sort of annual resurrection antedating the sources of Easter. And as each of the months brings changes in weather and in animals and plants, it suggests a train of thought relating man to the natural world around him. Throughout, Professor Krutch is impressed with man's unwillingness to consider himself just one of the living things, to say, "We're all in this together." The untidiness of Nature puzzles him, and he concludes that "the God who planned the well-working machines which function as atom and solar system seems to have had no part in arranging the curiously inefficient society of plants and animals in which everything works against everything else . . ." in a struggle that "goes on inconclusively millennium after millennium."

The neutral position of Nature in these

struggles for survival seems particularly strange since man is so ready at all times to take sides. The author feels the futility of interference but notes a diminishing interest in doing so, a casual or negligent attitude toward life, as the size of the organism decreases. When confronted with single-celled animals visible only through the microscope, Professor Krutch finds himself wondering about his relationships to them. To him the discontinuity in size separates his activities from their worlds far more completely than from any possible men on Mars. No interplanetary travel can bridge the gap and allow him to understand their lives. Even among some things slightly larger, the same problem exists for him. "Two-

**Answers to Quiz on page 333**

1. MALE (it's his love song, some experts say)
2. BOTH (females' are shorter and less curved)
3. MALE 90% of time, but female has occasionally been heard to sing
4. FEMALE (male feeds on plants)
5. FEMALE (with few exceptions, since they attain the salable length of 6", while males rarely attain 5")
6. BOTH
7. MALE
8. MALE (female replies with weak chirp)
9. FEMALE
10. BOTH (in all other North American deer, only males have antlers)
11. FEMALE (male seldom bites. It feeds on pollen and plant juices.)
12. MALE
13. MALE
14. FEMALE (but they're sexually undeveloped)
15. BOTH
16. MALE (but years ago, before present restrictions, both sexes were taken indiscriminately)

legged creatures we are supposed to love as well as we love ourselves. The four-legged, also, can come to seem pretty important. But six legs are too many from the human standpoint. Nothing that has them can be regarded with any sense of great intimacy."

The distinctive feature of life in the country around the year is not that "it is empty or that nothing happens, but quite simply that there is so much here which is not man . . ." The whole book stresses the importance of human kinship to living things as a guide in making man more humane, less machine-like, with warmer thoughts and stronger emotions. Faith in the future, in the return of the seasons, in the continuity of life and of man, is the essence that the author distills from observations near his Connecticut country home.

LORUS J. AND MARGERY J. MILNE.

## OUR SUMMER WITH THE ESKIMOS

----- by Constance and Harmon Helmericks

Little, Brown and Company, \$3.50  
239 pp., 33 illust.

GOING to live in Alaska appeals to thousands of young people in the States, particularly those in the Northwest, as an adventure of the sort that our grandparents experienced on the American frontier during the last century. The few hundred who actually do go each year discover that Juneau, Anchorage, Fairbanks, or Nome are very similar to any small town "outside," and the jobs they must take to earn a living are no different at all. The Helmericks are representative of the small percentage who, having escaped from the United States Midwest and having been transported to Alaska (at a very high freight rate), actually do become acquainted with the country.

This book tells the story of a summer's experience in a fairly simple and straightforward fashion. They left the cabin in which they had spent the winter on the Alutna River, just south of the Brooks Range, and after some difficulties had themselves and a small outfit flown over to Umiat on the Colville. Here they assembled a canoe and with a small



Photo by Greuzemann, from Leon

▲ TAKE-OFF "in tandem": a remarkable action shot of godwits taking flight

motor went down to the Arctic Ocean and eastward to Beechy Point, where they found a trading post and a small concentration of Eskimos. These people are the rather acculturated remnants of the fairly large population that once lived

up the rivers that flow down to this north coast, and the Helmericks' incidental descriptions of their present customs and attitudes are the best parts of the book.

Misadventures building a sod house, trying to accumulate fuel for the winter, and acquiring an outfit of skin clothing are detailed. They went caribou hunting and sealing and made a trip to Barrow for supplies for the native store at Beechy Point. None of the mistakes that all strangers make in this exacting environment are glossed over, and the obvious honesty of this simple story recommends it. This is the second in a series of three books narrating the extended journey made by the Helmericks in northern Alaska.

JAMES A. FORD.

**Winners of the Minerals Cryptomaze** in the May issue of *NATURAL HISTORY*: The three contestants submitting the highest number of minerals listed in the main section (A-Z) of *Webster's New International Dictionary—1948* (unabridged), in accordance with the rules of the contest, are: HAROLD EATON, Jackson Heights, N. Y.; DR. HENRY S. RICH, Bronx, N. Y.; MISS STELLA KRABENHOFT, Sabin, Minnesota. Each of these winners has received a copy of the *Manual of Mineralogy*, by Dana and Hurlbut, published by John Wiley and Sons, Inc.

# MUSEUM ANNOUNCEMENTS

## **Museum Expedition Leaves for Afghanistan**

The first American archaeological expedition to Afghanistan left the American Museum of Natural History by plane on July 12 for Karachi, India. Led by Walter A. Fairservis, Jr., special field assistant of the Museum's Department of Anthropology, the expedition is seeking traces of what are believed to be some of the earliest cultures in the southern areas of Afghanistan near the Dasht-i-Margo, the fabled "desert of death."

The expedition will work in co-operation with the Afghanistan Ministry of Education in exploring areas that it is hoped will yield evidence of prehistoric cultures in Central Asia. According to Mr. Fairservis, these prehistoric cultures in Afghanistan may have been among the earliest forerunners of basic eastern and western civilizations.

This will be the first of a series of expeditions that may cover several years. The explorations will be divided into two general phases, consisting of studies of the Paleolithic period and the earliest Neolithic, ranging from 2000 to 3000 years B. C.

Mr. Fairservis is accompanied on the expedition by Louis Dupree, a graduate student in archaeology at Harvard University, and Henry W. Hart, an architect and graduate student at Yale University. Dupree accompanied last year's Peabody Expedition, which explored traces of prehistoric man in French caves. Fairservis did extensive archaeological work in Mongolia and China during the past war and has also worked on the famous Mongolian collections of the American Museum's Central Asiatic Expeditions. The expedition will also be accompanied in the field by several Afghan students, who will assist in excavations and will be trained in field study activities.

Special field equipment was sent ahead by boat, to be picked up by the expedition at Karachi. The archaeologists expect to remain in the field for approximately six months.

## **Expedition to Upper Amazon Tribes**

Lewis N. Cotlow, whose previous explorations have taken him deep into the jungles of Central Africa and the Amazon Basin, is making his third visit to the Jivaro Indians (pronounced HEE-va-roe). This Ecuadorian tribe is popularly known because of its practice of shrinking human heads to the size of an orange. From Quito, Ecuador, Mr. Cotlow expects to travel to Cuenca to establish his operational base and thence into the territory of the Jivaros. He is accompanied by Jules Van Dyk Bucher, noted motion pic-

ture photographer, and expects to spend about six weeks in the Jivaro hinterland.

After a similar mission in Peruvian Amazon Territory, the party plans to travel down the Amazon from its headwaters to the sea, a hard and difficult journey of 3000 miles, of which the first 800 are the toughest. This journey will include a protracted stay among the Yaguas Indians. These, because of their long fiber skirts, were believed to be women warriors by the Spanish conquistadors and are the reason why the river was called the Amazon.

While the primary purpose of the expedition is to obtain motion pictures and still photographs of little-known Indian tribes, Mr. Cotlow hopes also to collect ethnological material for the American Museum. He expects to return to New York late this fall.

## **Donkey "Skeleton-in-Motion"**

The final masterpiece of one of the great osteologists of the century, the late S. Harnsted Chubb, has been placed on exhibit recently in the Hall of Comparative Anatomy at the American Museum. This exhibit will rank high among the more than 30 other examples of Mr. Chubb's artistry on display in the Museum—creations that won him worldwide acclaim as the originator of truly artistic "skeletons-in-motion."

In this exhibit, a donkey is shown in the posture it assumed when fighting off the attack of a botfly by gnawing its hind leg with its teeth. It would be hard to imagine any position more difficult to depict accurately yet gracefully, but like all of Mr. Chubb's other masterpieces, this is a true work of art as well as a scientifically accurate representation.

Students of art, to whom anatomy is of such fundamental importance, have always received inspiration and technical enlightenment from Mr. Chubb's mountings.

## **Eskimo Life Portrayed**

An unusual collection of photographs from the shores of the Arctic Ocean will be on display at the American Museum until September 7. The exhibit comprises approximately 45 pictures showing the influence upon the Eskimo of American and European contact and portraying the modern life of one community in northern Canada.

This remarkable series is the work of the Reverend Canon J. H. Webster, missionary of the Church of England at Coppermine in the Northwest Territories, Canada, who has spent 22 years in the arctic.

The exhibit, entitled "In Parka and

Igloo," is made up of four groups of black-and-white photographs: People, Building a Snowhouse, Travel by Dog Team, and the Search for Food.

## **In the Planetarium**

During September, visitors to the Hayden Planetarium will have opportunity to inquire into the mysteries of time and timekeeping, in a program entitled "Time by the Stars." The demonstration will explain how the astronomer checks his time by the stars, why our clocks and watches differ from sundial time, and other related questions.

## **Wildlife Poster Contest**

Again this year the annual Conservation Poster Contest of the National Wildlife Federation will be held for contestants in all grades from the seventh through the twelfth in high schools. The contest will be divided into two groups, with a separate prize for each. Group No. 1 will cover all contestants in the seventh, eighth, and ninth grades, and the first prize will be \$100. Group No. 2 will cover the high school grades through the senior year, and the first prize will be \$250. The subject of the poster is: "Soil and Water—and Their Products." All entries must be received by January 10, 1950. Rules of the contest may be obtained by writing to the National Wildlife Federation, Washington, D. C.

## **Mammoth Cave Threatened**

Kentucky's famed Mammoth Cave is seriously threatened by a proposed flood control dam across the Green River near Mining City, according to the Wildlife Management Institute. If the dam is built, periodic flooding will permanently damage characteristic geological formations in the cave, the National Park Service points out. Water level retention above 421.2 feet will cause flooding of both the Echo River and New Discovery sections of the labyrinth, and plans call for a maximum surface elevation of 450 feet.

The Mammoth Cave area was purchased by the people of Kentucky at a cost of millions of dollars and was presented as a gift to the people of the nation. Conservationists feel that the recreational and educational values of the cave cannot be replaced by artificial means and that the invasion of such an area by flood control and power projects is not consistent with the public purpose behind it. The National Park Service firmly supports this view, and the Secretary of the Interior has already protested vigorously to the Secretary of the Army against the construction of the dam.



*October*

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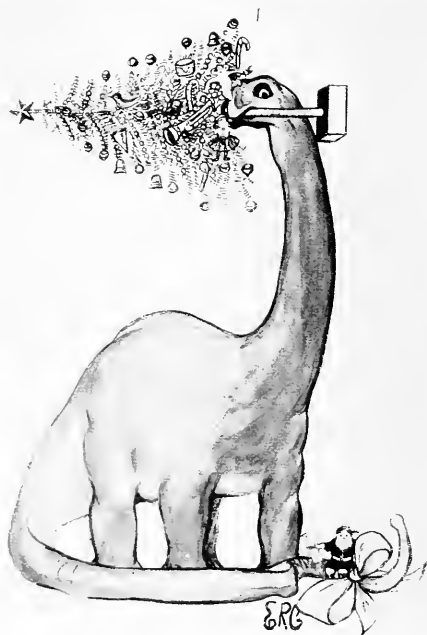
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# LETTERS

## *True Feel of Nature*

SIRS:

Like many out-of-towners, I thought for a long time that New York City had everything to offer except the true feel of Nature. That was before I came to the city and discovered that a dime's subway ride would deposit me in a jungle where hundreds of animals climb, leap, creep, and pounce—motionless behind their glass cages, each frozen into its own lifelike stance in its own natural habitat. Animals from every continent and from all the oceans, right in the midst of skyscrapers.

Recently, I decided to spend my few days of vacation doing animal sketching, and, naturally, I first searched the zoo for models. There I found plenty of material, but, believe me, the material did everything but pose. So I tried my luck before the glass cages in the American Museum. Not only did I find models that willingly posed for me in their most natural positions, but I discovered fishes, birds, and other animals that I had never known existed. And what amused me most (like a photographer who prefers "candid" of people rather than studio poses, I, too, wanted my models to "be themselves"), the animals, though stuffed, appeared to retain their special personalities. The ferocity of the shark is



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GRAY OWL

BLUE & YELLOW MACAW

GREAT POTOO



SAILFISH



MAKO SHARK (MAN-EATER)



MOOSE (FEMALE)

written in its face. The male chimpanzee is a show-off, while his spouse regards him resignedly, obviously unimpressed by his uncouth antics. The aardvark totters about without a single opinion on important issues, while the pelican grins apologetically at its odd appearance. The cow moose, despite her size, is suffering from an inferiority complex. The lion, on the other hand, has no doubts about himself and looks about with contemptuous assurance. The elephant has a reputation to maintain and is trying hard to look wise, educated, and like someone who has plenty to say. The Alaskan bear surprised me; he seems to have a humble opinion of his place in life and manages to look quite gentle and self-effacing. The gibbons are completely unself-conscious, which is something you certainly couldn't say of the capybara. And so on. Every one of the animals appears with an individuality of its own.

When I finished these drawings, it occurred to me that, since they originated right in NATURAL HISTORY's own home, your readers might enjoy a few of them. Perhaps there are many like myself, who did not realize what fun there can be in sketching in this great museum. It is like traveling wherever you want to go. I felt like quite an explorer before I was through.

STEPHEN BAKER.

New York, N. Y.

Artists can get folding chairs at the door, and there are thirteen acres of jungle and desert, sea and sky. Wheel chairs are available for "convalescent explorers." The American Museum of Natural History is open to the public every day in the year, and there is never an admission fee.—Ed.

### Sea Monster

Sirs:

In October, 1946, I was notified that an odd-looking animal had been discovered lying on the beach at the southern tip of the Kenai Peninsula, Alaska.

Mr. William Renfrew, a local attorney, flew me to the spot in his float-equipped plane. The animal was eighteen feet, ten inches from tip to tip. The head measured three feet, six inches long and two feet, two inches wide. There were 22 teeth in the lower jaw and 20 in the

upper. The actual tooth, when extracted from the jawbone, measured four and a half inches long.

An anthropologist from the University of Alaska made a special trip to view my pictures. However, he could not make a positive identification, and when he reached the place on the beach, a bad storm had destroyed all the remains except a part of the skull and the backbone. At no time could we find evidence of the rib structure. However, the anthropologist expressed the opinion that the animal was a species of killer whale. The question is still debated here in Alaska. Perhaps you can settle the argument.

DON KNUDSEN.

Anchorage, Alaska

The following comments are offered by Dr. Harold E. Anthony, Chairman and Curator of the Department of Mammals at the American Museum:

It is not often that reports of sea monsters, of dubious identity, are as well documented as the one photographed and described by Mr. Knudsen. With such evidence as he supplies, we could doubtless find a suitable name even for the Loch Ness monster.

The animal beached on the Kenai Peninsula is the Pacific Killer Whale, *Orcinus rectipinna*, a giant member of the porpoise family. The large teeth and the size of the animal make the identity certain. Killer Whales are not uncommon in

Continued on page 382



# NATURAL HISTORY

*The Magazine of the American Museum of Natural History*

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VOLUME LVIII—No. 8

OCTOBER, 1949

Great Horned Owl.....Cover Design

*From a Kodachrome by Hal H. Harrison*

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*With the imagination of a Maginot, the Inca ruler built a series of forts that culminated in mighty Sacsahuaman*

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*Their extraordinarily long, grasping tail figures prominently in their unsurpassed treetop acrobatics*

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*What man is earthbound, when a crumb for a bird can build a ladder to the sky?*

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*Nature's inlay is more real and convincing than any handiwork man could create*

You will find NATURAL HISTORY Magazine indexed in *Readers' Guide to Periodical Literature* in your library



## THE COVER THIS MONTH

The Great Horned Owl is our only large owl with ear tufts or "horns." With its length of about two feet and wing-spread of four feet or even more, it is our fiercest and strongest owl, and it is a formidable enemy of many woodland creatures. However, it draws most heavily on the ranks of the prolific rodents, including farm rats, and is valuable in controlling tree-girdling species like rabbits.

As early as February, the Great Horned Owl may be seen nesting, even when snow covers both nest and bird. It rarely builds its own nest, taking instead the nest of a hawk or crow, and it will protect its young with a ferocity that prompts the observer to approach cautiously. Like other owls, it hunts at night or at dusk, and especially in autumn its deep-toned hoots and blood-curdling shrieks provide one of the woodland's most eerie vocal effects.

The Great Horned Owl seeks shelter in dense forests and swamps and may be seen in suitable environments in almost any part of the United States. The color photograph reproduced on the cover was taken by Hal H. Harrison.

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## ART AND SCIENTIFIC THOUGHT

----- by Martin Johnson

Columbia University Press, \$3.00  
200 pp., 16 plates

THE relationship of art to science, their complementary aspects of a whole, somewhat as the obverse and the reverse of a coin, seems possible as a thesis only in an age like ours. In the eighteenth century, when art was primarily representational and science depended upon the evidence of one's senses, the distinction between the two must have appeared more evident and beyond the need for reconciliation.

Dr. Johnson suggests that science has been frustrated in the past because of a failure to achieve a healthy relationship with art. Both are concerned with the communication of pattern, form, or structure. But where science builds on a logical basis and seeks to evoke in all minds a common and identical pattern, art may be fantastic and permit a variety of equally valid reactions. Even the contrast of the logicity of science and the fantastic in art, he suggests, is becoming blurred as modern science deals more and more with concepts beyond sense perception. One might comment on this notion by pointing out that the concepts of modern physics and chemistry are sense perceived by mechanical extensions of our senses and aim at the discovery of the real real behind the apparent real, quite unlike the modern aesthetic formulations of pure abstraction.

To illustrate his general thesis that science and art must be reconciled, Dr. Johnson presents first a series of essays on what he calls the fantastic or imaginative element in art. These include Beethoven's final quartets, Chinese jade carvings, Byzantine manuscripts, Gothic ivories, the Russian ballet, and the poetry of Walter de la Mare. In all these forms of art, structures and patterns are paramount. Their pertinence, however, is not

always exactly striking, especially since no one is likely to contest the existence of form in these examples of art despite the highly individual interpretations possible of any one of them.

Following this, the author deals with several examples in the history of science of the failure of the scientific and the imaginative to maintain a healthy balance. The final section is devoted to an analysis of Leonardo da Vinci as a supreme example of a great spirit frustrated by the lack of a scientific sympathy in the age in which he lived. This analysis, as well as those of earlier periods of scientific frustration, are presented with scholarship and insight. The claims are interesting and novel, if not completely convincing.

HARRY L. SHAPIRO.

## THE STORY OF JADE

----- by Herbert P. Whitlock  
and Martin L. Ehrman

Sheridan House, \$12.50  
222 pp., 179 illu.

ONE of the great disappointments of

Mr. Whitlock's life was the unfortunate series of events that delayed the publication of his final work until after his death. We have waited many years for this capstone to Mr. Whitlock's American Museum of Natural History career as Curator of Minerals and later, as Curator Emeritus and Research Associate in Jade.

Mr. Whitlock's familiarity with jade came late in life, as he found himself thrust into the study of Chinese art and symbolism during the time of his acquaintance with Dr. Isaac Wyman Drummond, to whose memory this book is dedicated. He prepared himself well for the later

gift of the Drummond Collection, which included many notable jade objects and contained many primitive-type ceremonial pieces, so different from the stylized and finished carving of the classical Chien Lung time. As his study of the significance of the carvings progressed, his interest became less mineralogical and more mystic. He read all that he could find on the subject, and he discussed the topic with authorities from other institutions. From this he evolved a very clear picture of the significance to the educated Chinese of the many figures that we find in the carvings.

Much of this lore he has placed in his final book. It is not of as much interest to mineralogists as it is to the collectors and lovers of fine jade carvings. In it are explanations of the traditions that impelled the artist to use this or that motif on his piece. And natural history is there in truth—depictions of the tortoise, the fish, the bat, the hare, the lotus, and the peach of immortality.

It contains so many scattered bits of Chinese myth and legend that it is not a book to sit and read; it is one to which to refer when some particular point is brought up or in which to find an explanation of some special combination of symbols. Besides, it is a handsome book, beautifully illustrated and nicely presented—truly, a worthy setting for the final publication of one of our curators of whom everyone was fond.

F. H. P.

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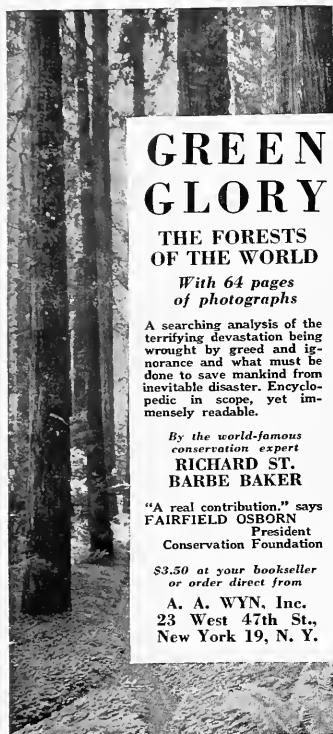
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many different fields of conservation, the brief discussions suggest some of the many aspects of each topic. The definitions are those of a layman and, although scientists will not agree with all of them and will find many oversimplified, that undoubtedly constitutes the book's greatest virtue for the average reader.

RICHARD H. POUGH.

## HISTORICAL GEOLOGY

----- by Carl O. Dunbar

John Wiley and Sons, \$5.00  
567 pp., 350 figs., 17 illu.

EVERYONE interested in natural history should have in his library information on the history of the earth and of its life. Here is a book that can be highly recommended for this purpose. It summarizes the whole subject, from the origin of the earth to the coming of man, in the light of the latest discoveries and with the unexcelled authority of the Professor of Paleontology and Stratigraphy and Director of the Peabody Museum of Yale University.

General principles are stressed, and the discussion is organized around these. The abundant illustrative details are drawn almost entirely from North America, bringing the story close to home for American

readers and travelers. The numerous, carefully selected figures include magnificent photographs of rock outcrops and geologic features, restorations of a great variety of prehistoric animals, and 34 new maps of the inferred geography of North America at different times in the past. These maps represent in the main the last work of the late Charles Schuchert, acknowledged leader in this study. They ingeniously avoid appearance of knowledge where none exists by attractive use of clouds over marginal parts of the landscape.

This is a textbook for college courses in historical geology. It is a new book, but it succeeds and in part derives from the classic and time-tested Yale text, successive versions of which were written by Pirsson and Schuchert (1915), by Schuchert (1924), and by Schuchert and Dunbar (1933 and 1941). The success of Dunbar's new version for class use can be confidently predicted. Although not intended primarily for self-study, the book is among the best for anyone seriously interested in this subject. Such a reader will, however, also want more explicit direction for obtaining regional geologic information.

A set of color slides further illustrating the text is available from the publisher.

G. C. SIMPSON.

## SPORTS FISHING BOATS

----- by S. Kip Farrington

W. W. Norton, \$4.00  
154 pp., 71 illu.

SOONER or later this book had to be written. That it has been written and is now available to the sports fishing public is another creditable milestone in the progress of the author, who has in previous books shared his widespread angling experiences with others.

In the introduction to Farrington's latest publication, Michael Lerner calls attention to the popularity of angling throughout the world and describes the author as being eminently qualified to write about sports fishing, the boats, and other equipment employed in this highly interesting pastime. Mr. Lerner's stamp of approval, thus expressed, should be all that is needed to assure other anglers (if, indeed, such approval is needed) that the book is worthy of a choice place in their libraries.

One of the fine things about the book is the simple and straightforward manner in which it is written. From the begin-

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ning to the end, there is no doubt in the reader's mind concerning the author's knowledge of the subject he is discussing. Each chapter is complete in its details. There is no glossing over, and there is no pussyfooting. Farrington certainly calls a spade a spade. He tells why he likes certain boats and their equipment in a positive manner, and if he doesn't like certain other boats and their equipment, his statements are just as positive. He describes the boat that is ideal from his point of view. He tells of the thrill of catching fish from your own boat, and he goes thoroughly into the matter of choosing a fishing guide to operate your craft. He tells of his choice in fishing equipment, and he tells why he has favored it. He points out the pleasures that may be derived by combining cruising and fishing.

In other words, *Sports Fishing Boats* is a complete detailing of the subject, thorough and sound, authored by a sportsman who has, perhaps, fished in more boats and more places than any other living angler. It highly deserves a special niche in every sportsman's book collection.

ERL ROMAN.

## WILD FLOWERS IN THE ROCKIES

----- by George A. Hardy  
and Winifred V. Hardy  
Illustrated by Frank L. Beebe

H. R. Larson Publishing Company  
301 1st Ave. N., Saskatoon, \$7.50  
125 pp., 50 illu.

THE freshness and delicacy of Mr. Beebe's treatment of his paintings is perhaps the first thing to strike one on opening this little book. The right-hand pages throughout are devoted to colored reproductions—four to a page—from Beebe's originals in water colors. For the flower-lover who wants to become acquainted with the form and appearance

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of wild flowers and has not too great a curiosity regarding their structure, these attractive paintings are just right.

The text to each set of four pictures is carried on the opposite page. On the wrapper the writing is described as "almost lyrical, giving the reader . . . a feeling of almost sensual pleasure." In an average of nine lines to the species Mr. and Mrs. Hardy, by abbreviating the purely descriptive parts to the utmost, contrive to leave themselves four or five lines for lyricism. And they do it well. Of the water knotweed, for example, they write ". . . Like little torches held erect above the surface, they flaunt their charms in undisputed rule among their kind . . ." Actual description is boiled down to "flowers" one line; "leaves," one line; "height" and "habit," one line shared between them.

The familiar plan of classification by color is adopted—a good enough plan when the color of the flower is unequivocal; but because of the vagaries of some species this method is not always satisfactory. In this book the arrangement is yellow, blue, pink to purple (which includes red), and white to green.

*Wild Flowers in the Rockies* really refers to the Canadian Rockies, with special emphasis on the flora of Jasper National Park and Banff National Park.

Some 200 of the approximately 500 species in the area have been portrayed. These represent 42 plant families. Such concentrated description naturally requires a glossary to explain the botanical names employed, and one is provided. There are also a brief list of references and indexes to common and technical names.

C. H. H. TATE.

## THE NATURAL HISTORY OF MOSQUITOES

----- by Marston Bates

The Macmillan Company, \$5.00  
379 pp., 16 plates, 9 figures

IN bringing together a summary of almost everything that is known about mosquito biology, Dr. Bates has rendered a distinct service to every student of these generally unpleasant insects, including students of medical entomology and those interested in public health. The question of mosquito control is not considered except for the natural control by their enemies, contained in a chapter on "Mosquitoes in Relation to Other Organisms."

Dr. Bates discusses the habits of the adults, including the time and distance

of flight, their resting places, length of life, and the seasonal distribution. All of these show definite variation among the species that have been studied up to the present time. Many kinds of mosquitoes travel as much as a mile; a few travel farther; and some are much less explorative. The food habits of the adults are varied. Some prefer mammals of certain kinds, and man is generally not a preferred host. The wild four-footed animals of any region are the preferred hosts, but as a rule domestic animals, such as donkeys, horses, cattle, and goats, furnish desirable meals. Some kinds feed as readily upon Guinea pigs as upon donkeys, but others ignore Guinea pigs if other food is available. Some kinds of adults live only on the juice and nectar of plants; indeed, this is probably true of all male mosquitoes, although there have been reports of males sucking blood. In cases of this kind, it has generally been found that the biting "males" were hermaphrodites or gynandromorphs.

The eggs are generally distinctive, and close study of them enables the specialist to recognize the genus and very often the species. In *Anopheles*, the malarial mosquitoes, the eggs of each species are recognized especially by variations in the "floats," but other characters are also available.

The larvae, or wrigglers, all differ both in minute characters and in their habits and habitats. Most mosquito larvae live very close to the surface of the water, but there are some deep-living ones that obtain their oxygen from the stems of aquatic plants. Some prefer shade, while others like sunshine. They live in water wherever it is found, but none live in sea water. Holes in trees and the axils of plants hold enough water to produce mosquitoes adapted to that type of existence. The pupae conform to the larval habitat.

There is much about the diseases transmitted and more about the separation of species and races and the classification of mosquitoes. Laboratory and field studies, and the many problems posed by these phases of study, receive full attention, based upon the long experience of the author as a field officer with the Rockefeller Foundation in Europe, Africa, and South America.

This is essentially a textbook and reference, but it contains a world of knowledge, presented in an interesting and readable manner, so it will appeal to the layman who has only a slight interest in these pests.

C. H. CURRAN.

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▲ "THE INCA RULER," with a young Nusta, or "Woman of the Sun"

he would be dashed to pieces and become offal for the birds.

The tremendous amount of manpower necessary for such an enterprise was supplied by the *mit'a*, a primitive system of labor service by which each taxpayer was required yearly to give a certain amount of time to the state. Through this system, many thousands may at times have been at work on the fortress; and by the time it was completed, there was scarcely one in all the realm who had not had some contact with it, whose sons, brothers, fathers had not worked on it.

Much of the limestone used was quarried close by. Just north of the fortress, over the plateau, two graded roads to the limestone quarries are still distinctly visible; and within the quarry area, partly fash-

ioned rocks can still be seen. All of Sacsahuaman, however, is not of limestone. When the Indian architect desired something unusually durable, he had the laborers drag huge polygonal blocks from quarries as far distant as 21 miles; this type of rock was used in the finest, most solid of Inca construction.

How did these Indians cut the huge rock masses and then move them overland? How did they move one of the greatest single pieces of the fort—a monolith 27 feet high, 14 feet broad, 12 feet thick, weighing upward of 200 tons? The answers can only be phrased in broad terms. As for tools, their principal and practically only implement was the stone celt, for despite the fact that the Incas and other tribes worked bronze, gold, and silver, they were architecturally in a neolithic, or "new stone age," stage of culture. For transporting the rocks, the Indians had neither horses nor oxen until after the Spanish conquest; the domesticated llama was capable of carrying only 75 pounds and was never used for draying. The stones were dragged by human power alone, pulled over wood or stone rollers by ropes made from the tough fibers of the agave. A ramp of

earth was constructed to raise the burden to its appointed place.

Like certain other advanced Indians, the Incas slit huge masses of rock by drilling and inserting wooden pegs which, when wetted, swelled and cracked the rock. Also, they heated the stone with fire and then doused it with cold water, which also caused splitting. They finished and dressed the surfaces with celts of stone.

It is presumed that they worked from some sort of pattern. A workman would bring to the quarry the shape, more or less, of a desired stone, and a piece was selected that could be trimmed to the proper dimensions. This stone was then dragged to a designated spot, where it was cut, shaped, and dressed until all its sides would fit the other rocks about it, no matter how erratic the angles. Each stone was made slightly beveled on the face, and near the joints it was worked down sharply to the faces of the surrounding rocks. Time has, in some instances, altered this perfect alignment; weather erosion, earthquake, and violence have made some changes. Yet the edges are still wonderfully fashioned and cut with a precision that inspires the



▲ THE FOUNDATION of one of the square towers, from which the Indians made their last stand in the siege of the fortress by the Spaniards over four centuries ago. It was near here that the Inca chieftain, seeing defeat certain, plunged over the battlement to his death



▲ THE SIZE of the three mighty bastions can be judged from the human figure in front of the lower wall at left

admiration of all who see them. It is almost impossible to conceive, without seeing it, the variety of shapes of these stones and the apparent facility of the Inca stonemasons in handling them.

Year after long year passed while stones were transported and fitted together, and the raw materials grew into this structure of tremendous proportions. We don't know the exact date, but perhaps about the year 1508, 70 years after it was begun, there stood the greatest work the American native ever produced.

Facing the city of Cuzco, the eminence of the fortress presents a sharp, steep front, almost perpendicular, in itself almost impregnable. The Inca military architects, however, took no chances; on these heights they built three stone terraces, hard to scale, easy to defend. The principal fortifications of Sacsahuaman, facing directly north,

dominated a huge flat pampa. Along this side for 1800 feet, almost  $\frac{1}{3}$  of a mile, ran a herculean wall composed of 3 massive lines, broken into 46 parts, each supporting a terrace and parapets rising to a combined height of 60 feet. It was not, of course, a solid wall but was cunningly built with salients, retir-

ing angles, and buttresses, making it so formidable that no Indian enemy ever attempted its direct assault.

There were only three entrances to this huge fortress, three doorways only large enough to allow one man to pass through at a time, with one doorway for each of the

*Photo by A. Guillen*



➤ ON THE TERRACES below Salla Marca Tower are the ruins of the dwellings of the fortress refuge



▲ THE CENTRAL DOORWAY leading to the third tier of forts, where only a few warriors were needed to hold off a body of the enemy. It was the forcing of this gateway by the Spaniards in 1536 that led to the fall of Sacsahuaman

► A FLOCK OF LLAMAS in front of the great walls of Sacsahuaman, showing by comparison the immense size of the blocks



three tiers. To enter the fort one had to pass through these or scale the sixteen-foot walls. The gates led from one parapet to another, through the sieve of defenses, to the top of the fortress where there seem to have been two square military towers, one at each end.

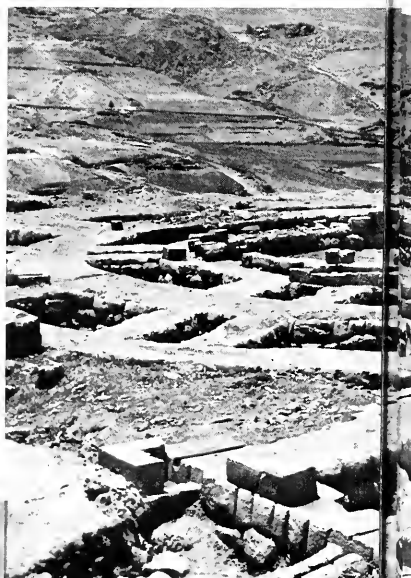
At the extreme east end of the fort, where the principal buildings were located, was the circular foundation of Muyu Marca. Although archaeologists disagree as to its precise functions, Dr. Luis Valcarcel, who excavated the structure, believed it to have been a reservoir, with a capacity of 50,000 gallons. It was still standing in 1560 when the Inca historian Garcilasco de la Vega left Cuzco for Spain, and he described it as a reservoir "of good water, brought from afar, under the ground." However, this chronicler often mixed fancy with fact, and his description has been doubted. How the water was brought up to the reservoir, which stands 50 feet above the plaza, still remains a mystery.

On the upper level of the fort, facing toward Cuzco, were the quarters of the commander of the fort and its soldiers, for Sacsahuaman had a permanent garrison that guarded the walls and kept in repair a great storehouse of arms—"bows, arrows, lances, copper axes, and cotton jackets," wrote a conquistador who saw them. In addition to the barracks for the troops, there were houses for the priests of the sun and habitations for the Inca and his principal officers—structures

► THE BASE of Muyu Marca, which is believed to have been either a circular tower or a reservoir for water

whose exterior walls were covered with gold, beaten and shaped into place in such a fashion that the stones looked more like golden ingots.

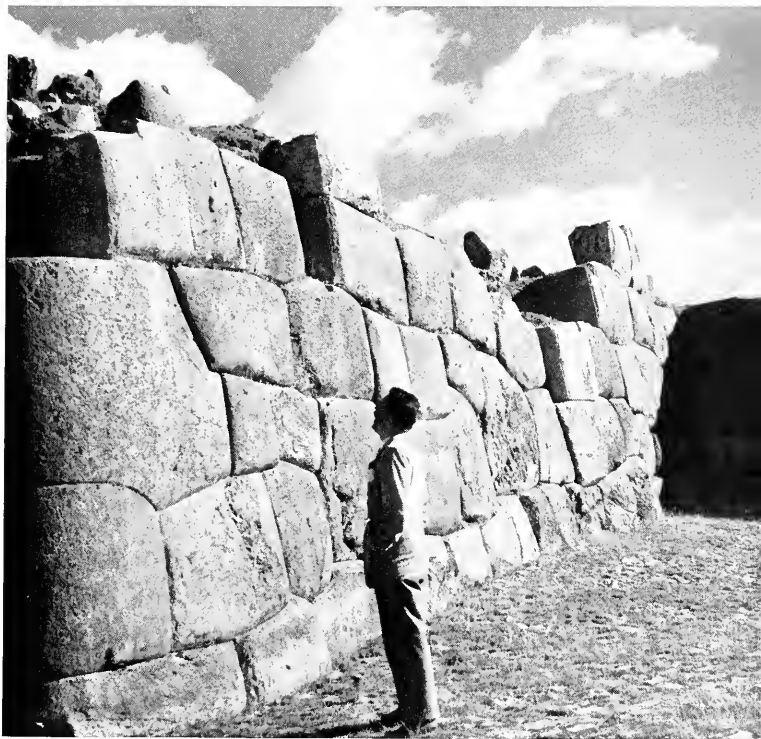
Sacsahuaman was, in fact, Cuzco in miniature, with its soldiers, priests, Nustas (selected women), and nobility in constant attendance. It was not, in a proper sense, a fortification; it could not prevent an invasion of Cuzco, for it commanded only one road, to the north. It was a refuge for the people in case of general attack, a place where sacred treasures could be stored and where the soldiers could withstand, if hard pressed, a siege for months.



There are rumors, never confirmed by actual excavation, that the city was connected with the fortress by a tunnel through which the people could escape in case of assault. Such a tunnel, a half mile in length, cut through solid rock, overtaxes one's credulity; but in view of what the Incas did accomplish, some have accepted its existence. It is certainly true that the fortress was honeycombed with tunnels, high enough for soldiers to pass erect from one place to another. In these underground rooms, the Incas placed their trophies; here, too, they stored their golden objects against confiscation by possible invaders.

Even when one discounts the legends that have grown up about it, this mighty fortress, with its golden-plated buildings, its painted walls, its throngs of soldiers and nobles, must have seemed, to those who saw it at its apogee, one of the great edifices of Peru. Word of its marvels went even beyond the far-flung Inca borders and so deeply awed all tribal enemies that none ever attempted to attack it. Sacsahuaman was considered impregnable, and so it was until the white man came.

The conqueror Pizarro made his capture of the Inca Atahualpa in 1533, and the fabulous empire collapsed. Later the Spaniards poured into Cuzco, taking possession of the



▲ THE HERCULEAN WALLS of Sacsahuaman show an intricate mosaic of massive stones, neatly shaped and bonded at the corners. The shaping of these blocks with stone tools and the transporting of them without draft animals inspire the modern visitor with wonderment and admiration

ancient capital and partitioning it among them. For two years the Pizarro brothers sat in the city, divided the wealth of the realm, and took over the Indians' functions, while Diego de Almagro, associate in the conquest, ever hungry for more gold, took off for Chile to search for his dreams. This division of the Spaniards left the city with only a small garrison headed by the three Pizarro brothers: Hernando, Gonzalo, and Juan.

On the night of April 18, 1536, the Indians suddenly rose in revolt against the white men who had usurped their empire and reduced them to slavery. All over Peru, at a given signal, the Indians attacked. They surprised men and women alike in this sudden burst of savagery.

The Spaniards were caught completely unprepared, for so sure

were they of the docility of the Indian that most of their troops had followed Almagro to Chile. There were less than 200 troops left in Cuzco, many recovering from wounds, and of these only 78 were cavalry. In addition, there were about 2000 Cañari Indians who detested their Inca overloads and had thrown in their lot with the Spaniards.

The uprising was led by the Inca Manco Capac. Created Inca by his conquerors, he soon understood that he was a mere puppet. On the pretense of bringing a golden statue to Hernando Pizarro, he was allowed to leave Cuzco. Once out of the Spaniards' hands, he planned revolt and planned it well.

All the chiefs of the various clans were called to the war meeting. It was agreed that they would simultaneously attack Lima, where Fran-





cisco Pizarro had founded his capital, envelop Cuzco, and wipe out all the isolated Spanish outposts.

On the appointed day, the Peruvians converged upon Cuzco from four directions. They came in great masses, like swarms of locusts. How many there actually were we do not know, but the Spaniard, rubbing his eyes in astonishment, said there were 200,000. In an upwelling of sound, in which the harsh notes of shell trumpets mingled with triumphant cries, the Indians moved upon the city.

Within hours, Cuzco was a "sea of flames," according to an anonymous Spanish knight who was there.\* Well did he remember the scene he describes, for in all the European wars in which his associates had participated there had never been a battle "so cruel and so pitiless." No quarter was given on either side. Because the roofs of Cuzco were of ichu grass and as inflammable as tinder, the city was soon ablaze. The Indians succeeded in the first few days in driving the Spaniards into the great plaza—Huakaypata. There beneath the light of the many fires, the white men were excellent targets for the missiles that rained down on them from the Indians at the base of the fortress. Death fell upon them night and day, and whenever one of the Spaniards had the ill luck to fall into the hands of the Indians, his head would next day be thrown back to his comrades, amid the constant rain of fire.

At the same time, the Indians attacked Sacsahuaman, killing the few Spaniards in attendance and disemboweling their Cañari vassals.

On the seventh day of the siege, the position of Cuzco looked hopeless. Couriers were sent to Chile to warn Diego de Almagro, but they never got through. Others were sent to Lima; all but one were killed. In Lima, Francisco Pizarro was having his troubles, too. The city was being attacked ferociously. Still, he managed to dispatch three relief columns to Cuzco. All, however, were decimated.

In Cuzco, it was chaos. The magnificent buildings the Incas had taken centuries to build were gutted, and those not destroyed were pulled down by the Spaniards to give room for their most effective weapon, the cavalry. But the Indians developed a defense against this, too. They put up an elaborate system of barricades and staked pits in the parts of Cuzco they held and outside the city limits.

For six weeks the Spaniards fought from house to house, retreating here, counterattacking there. It was a losing fight all the way.

Then fell a stunning blow, and it came from the mighty Fortress of Sacsahuaman, standing formidable and defiant on the heights of the city. From the base of the fortress the Indians fired every type of weapon they possessed—rocks, spears, fire bombs. The casualties on both sides were enormous, but every time a Spaniard was killed, it was as though 500 had died, so great were the odds against them.

It became obvious, we learn from our anonymous chronicler, that the Spaniards must either break the siege or perish. Hernando Pizarro, toughened by the interminable wars of Italy and not one to turn his back on a fight, talked to his men in the rough language of a soldier: "You see, men, that we are tired and worn, our horses galled. The fortress in the hands of the enemy is the source of all the danger that rains down on us. If we do not capture the fortress, we die."

So leaving a small force in the plaza, they split up into three assault forces and, with squadrons of Cañari Indians who remained loyal, they succeeded during the first days in driving the Indians back into the main fortress. They tried to force the gateways but were repulsed. Then, making crude ladders, they raised them against the great stone walls and from several sides began the assault.

Juan Pizarro, the youngest of the fighting Pizarros, tried on the third day to lead his group through one of the three doorways; but as he did not wear his helmet because of a head wound, he was struck by a

propelled rock and fell mortally wounded.

His death only served to increase the exertions of the Spaniards. The Incas were consequently forced to send reinforcements, which our anonymous chronicler, awed by the immense numbers of Indians, put at 5000. With the reinforcements came a command from the Inca ruler that the fortress was not to yield. But as the Spaniards continued to press the attack—always at night, because the Indians loathed night fighting—the Indians soon expended all their supplies of spears and stones.


The center tower, Salla Marca, was the last to hold out. The fevered Inca resistance died with the Inca general. In the words of the historian Prescott, "... the Spaniards ... overpowered the few combatants who still made a show of resistance. But the Inca chief was not to be taken; and, finding further resistance ineffectual, he sprang to the edge of the battlements and, casting away his war-club, wrapped his mantle around him and threw himself headlong from the summit."

The taking of the fort was the turning point of the struggle. Although the siege continued for 16 months, and 800 more Spaniards were killed, the Indians' attempt at reconquest was over. The final blow came with the return of Diego de Almagro from Chile with his great host of men; the Inca knew then that the test of strength had ended in Spanish victory.

A good part of Sacsahuaman was now reduced to ruins, and the capital city was rubble. The Spaniards removed most of the smaller stones from this great fortress, to rebuild Cuzco, and today Sacsahuaman is almost leveled to the massive rocks that form its bastion—an epitaph to one of the greatest battles ever fought in history. Yet, enough is left of this, the greatest engineering work of the American Indian, to imagine the rest. Broken but proud, the Fortress of Sacsahuaman remains as the early Spaniards wrote of it, "... greater than the bridge at Segovia or the buildings of Hercules."

\* *Relacion del sitio del Cuzco* (written in 1536) republished in Lima in 1934, pp. 9-24.





◀ THE TAIL is longer than the head and body together. Toward the end, its lower surface is hairless and forms a very sensitive grasping organ—almost a fifth hand

*Drawing by Museum Illustrators Corps*

exception is, of course, the monkeys in and around the cities and villages of India and other countries of the Orient, where they are regularly protected by religious custom and allowed to roam where they will—through gardens, streets, and bazaars—and frequently to pilfer to their heart's content anything in the way of food that they find unguarded. But monkeys that have not lived under such protection, or have, as in many countries, been regularly hunted for food or fur, display a very different attitude. Between these two extremes, we sometimes have the opportunity to observe the animals when, after having been kept in cages, they are allowed to roam with ample room among trees that are effectively isolated in some way to prevent their escape.

For such an opportunity to study the ways of spider monkeys, and others, I am indebted to my friend Mr. Frank H. Locey, who for many years owned a dairy ranch near Honolulu. The old Honolulu Zoo had been disbanded some years before, and all the larger animals had been disposed of, leaving only a few smaller ones and a collection of birds to form the Honolulu Bird Park. Due to his public spirit and interest in animals, Mr. Locey maintained a private zoo at his ranch for several years. He acquired an Indian elephant and three nearly full-grown chimpanzees from Mr. Christian R. Holmes' estate on near-by Coconut Island, as well as a Bactrian camel and several smaller animals, including monkeys of six different species. This compensated for the local deficiency to the satisfaction of hosts of Honolulu's children, who had free access to the zoo daily.

At one time a siamang gibbon was to be seen at Waialae Ranch; and for several months two spider monkeys, both females, were al-

# Spider Monkeys

Their extraordinarily long, grasping tails play a prominent part in their unsurpassed repertoire of treetop acrobatics

By THOMAS M. BLACKMAN  
*Photographs by the author*

MONKEYS of all kinds are a source of interest to young and old. When seen in the zoo, their lively and tireless activity draws crowds around their cages; but when seen in their natural environment among growing trees,

they present a far more interesting spectacle.

These animals are generally so shy and retiring in their natural state that even an experienced field naturalist finds it difficult to study their ways at close quarters. The

lowed their freedom in the trees surrounding the house and gardens. But most visitors to the zoo were not aware that this added attraction existed just beyond the fields of Napier grass, growing nine or ten feet high, between the house and the ranch buildings.

The spider monkeys remained there for several months, apparently quite contented with their lot, the only bar to their escape being the fields of grass surrounding them. They had the free run of a large Chinese banyan, two huge monkeypod trees, twenty tall coconut palms, and numerous smaller trees, including fig, mango, custard apple, carambola, and papaya. I need hardly say that they helped themselves to anything that took their fancy. They showed great partiality for figs and mangoes, and such fruits as they found edible seldom had a chance to ripen. These two monkeys quickly put an end to the nesting of house sparrows and ricebirds in the top branches of the large monkeypods in front of the house, but they were not aggressive toward birds that settled in the trees. Eventually, due to the cutting of some branches of the trees and the clearing of underbrush, the monkeys became alarmed, and next morning they were found to have crossed the surrounding fields to some trees bordering a roadway. There one of them came to an unfortunate end on some overhead electric wires, and the other was safely captured.

A while later two female crab-eating macaques were allowed their freedom in the same manner. By that time, the sparrows and ricebirds had rebuilt their eighteen nests in the two monkeypods, but the macaques quickly destroyed all the nests and apparently ate what eggs and young birds they contained. The monkeys then inspected the coconut trees, where there were nests of both myna birds and house-sparrows among the debris at the bases of the leaf stems. The monkeys were frequently seen to chase the birds out of such places. They would run along the midribs of the leaves until they swayed down-

ward so much that it was even difficult for them to hold on. Meanwhile the myna birds would chatter and scream and fly around, making repeated swoops to within a few inches of the monkeys in a fruitless attempt to drive them from their nesting places.

The spider monkeys, of which there are a number of species, are indigenous to tropical America; and it is evident in many ways that they are more highly specialized for an arboreal life than any other monkeys. Their extremely light weight enables them to climb with ease among the thinner branches of the trees where an animal of only slightly heavier build could not follow. Their arms and legs are remarkably long and slender, endowing the animal with great reaching power; and the prehensile tail, though it varies in length somewhat in different species, is generally longer than that of any other monkey having a prehensile tail. So light and attenuated is the whole animal that on first sight it has quite a weird appearance, with its tiny head, pinched and shrunken cheeks, strangely elongated hands and feet, and extremely long tail.

When the animal is not asleep, its tail is always on the move, slowly coiling and uncoiling, ever ready to take a firm grip on any object within reach. It serves not only as a fifth hand but also as a safe anchor, which is always ready to fix to a passing branch whenever the animal needs additional support or even in case of a fall. The tail is considerably longer than the head and body, and toward the end its lower surface is sensitive and devoid of hair, forming a very effective grasping organ. It is sometimes used as a rope by which to swing while hands and feet are in use for the purpose of gathering fruit and conveying it to the mouth. It might even be regarded as the spider monkey's most prominent feature, for it attracts one's attention far more than does the little pinched face.

The tail is frequently used to grasp objects that are not within reach of the hands and feet, and it

sometimes serves also as a life line while the animal sits dozing upon a branch high up in a tree, with the end of its tail twined around a thinner branch. But when there were no thinner branches within their reach, I sometimes saw these two monkeys, on hot afternoons, sleeping upon a thick horizontal branch in a more startling pose. Both were sitting lengthwise, one behind the other, each with its arms resting upon its knees, its head hanging forward upon its chest, and its tail curved upward, forward, and then backward, high above its head, in the form of a question mark!

In the tropical forests of South America large tracts of land become flooded annually in the rainy season; and it has even been suggested that this fact may have influenced the evolution of the prehensile tail among the monkeys and other arboreal animals of that continent. Such an explanation, however, is not without defect. To be sure, many of the monkeys of South America possess prehensile tails, whereas among the monkeys of other regions prehensile tails are unknown. And when leaping from tree to tree, monkeys are known sometimes to suffer accidents by falling to the ground. But after falling into a river, they have been seen to swim safely ashore. Actually, a fall into a submerged tangle of vines and other vegetation of a tropical forest might have more serious results.

Compared with other monkeys, spider monkeys are unusually quiet and gentle in their behavior; but they require ample room for exercise to exhibit their remarkable feats of swinging and leaping. Although fruits and nuts form their main diet, they search among the foliage for insects of many kinds. Those at Waialae Ranch appeared most to enjoy a large mantis, nearly three inches in length, which was sometimes quite plentiful. The monkeys often came down to the lower branches to take raisins from the hands of those whom they had learned to trust; and when offered a mantis they would snatch at it



▲ SWINGING confidently from its tail, the spider monkey uses its other members for gathering fruit or insects and conveying them to its mouth

quickly, as though aware that it might fly away. Taking it in both hands, they would hold it up and bite pieces from it at their leisure, in the manner of a child picking the wing of a chicken.

When at Waialae Ranch one evening I witnessed a demonstration of the agility and light weight of these animals. The sun was low in the sky, and as I sat looking across the lawn, its rays passed beneath the spreading branches of the great monkeypod trees and fell full upon the smaller fruit trees. While I admired the rapidly changing play of light upon the varied coloring of the foliage, I noticed a sudden movement in a small fig tree. A branch then bent downward, and the head of one of the spider monkeys appeared, raised high above the foliage to take stock of its surroundings. Again the branch swayed downward beneath its weight, and the monkey pulled itself onto a stronger branch, with

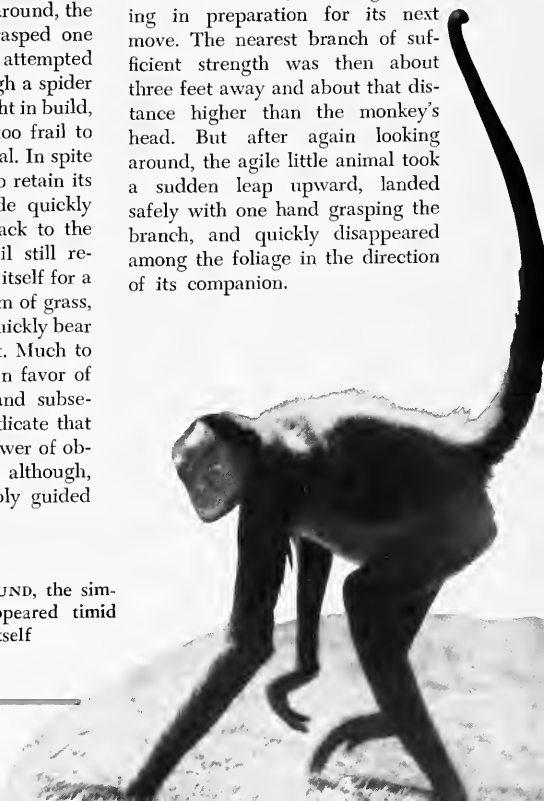
its whole body now clearly in view. Then, climbing along the branch, it was able to leap to the next tree, and it quickly disappeared from view.

Almost immediately its companion appeared, and I watched it as it climbed along the same branch until the branch again bent downward, this time lower than before. That did not seem to please the monkey, which was evidently intent upon following its companion. The branch continued to bend, and it went so low that it dipped into some long rough grass. The little animal seemed desirous of avoiding this grass, possibly from an instinctive dread, possibly from actual experience, for most likely these monkeys had been caught wild, in a region where snakes or other enemies may have lurked. Our little friend appeared to be undecided as to its next move. It looked anxiously around, and its attention was drawn to three tall stems of Napier grass growing near by. The stems were still green and scarcely half an inch in thickness but reached high above the undergrowth. After again looking anxiously around, the monkey reached out, grasped one of the frail stems, and attempted to climb upon it. Although a spider monkey is remarkably light in build, the grass stem was far too frail to support so large an animal. In spite of the monkey's efforts to retain its balance, it had to decide quickly whether to pull itself back to the branch on which its tail still retained a hold, or to trust itself for a moment to the single stem of grass, which obviously would quickly bear down beneath its weight. Much to my surprise, it decided in favor of the single grass stem; and subsequent events seem to indicate that it showed remarkable power of observation and foresight, although, in reality, it was probably guided

chiefly by experience. No sooner had it released its hold upon the branch than the grass stem began to sway over; but by a sudden movement the monkey grabbed another stem and pulled it until it crossed the one that was bending beneath its weight.

Although its fall into the rough grass now seemed delayed, the position of the little animal appeared little less precarious than before, for although the two grasses supported one another, both were now likely to sway over in either of two other directions, and the monkey still had a difficult task to maintain its balance. It seemed as far as ever from being in a position to make the upward leap into the small tree through which its companion had disappeared. Undaunted, however, it now reached out a hand and grabbed the third, and last, of the tall grass stems and pulled it across the other two. It then had, if not a firm support, at least a sort of tripod which might support its weight for a few seconds, provided it remained quite still. For a while it was motionless, as though resting in preparation for its next move. The nearest branch of sufficient strength was then about three feet away and about that distance higher than the monkey's head. But after again looking around, the agile little animal took a sudden leap upward, landed safely with one hand grasping the branch, and quickly disappeared among the foliage in the direction of its companion.

➤ ON THE GROUND, the simian aerialist appeared timid and unsure of itself





▲ THE DURABILITY of "grass-root" bricks is demonstrated by the old Isleta Mission, built before 1629 and still used as a place of worship

# The House That Grass

"I BUILD my house natural, out of grass and earth, like the world is made." The Spanish-American farmer was telling how he had grown the bricks for the family home.

Long stacks of these sod bricks, called "terrones," were piled in his front yard to dry in the intense New Mexican sunshine. They had been harvested from a terron field only two miles away, in bottomland along the Rio Grande between

Some of the oldest houses in the United States were built of grass-root terrones, which required no molding or baking, and their cost is one-third that of adobe

By ALTON A. LINDSEY

*Department of Biology, Purdue University*

Santa Fe and Albuquerque. After several months' seasoning, the stacked terrones would be laid up in the wall.

The builder picked up a brick to point out the infinite number of

small rootlets, in place as they had grown, firmly binding the heavy clay soil. The dried plant tops showed the roots were largely of salt grass and rushes.

"This is not what we call an



Barnes and Caplin photos from *Western Ways*

# Built

adobe," he explained. "Those are made by mixing adobe soil with water and straw, then molding the mix in wooden forms. But a terron—the grass saves us plenty work! I cut these with a machine dragged behind a truck. The Indians near here cut terrones by spade; they have for hundreds of years."

He turned proudly to the wall of his partly built house. Upon the standard concrete foundation he had laid up tiers of terrones to a

height of three feet. The fourteen-inch length was placed the long way of the wall; the width of the bricks determined the wall's thickness as eight inches, before plastering. The terrones were inverted so that the grass tops could be nestled firmly into the mud between the bricks. Orthodox bricklayers using cement mortar playfully term it "mud," while the terron-user mixes authentic mud and calls it "mortar." I asked why he had poured an expensive concrete foundation but used common, garden-variety mud for mortar.

"Pull that wall down," he invited. Seeing my hesitation, he grasped the upper tier and vigorously tried to shake the wall. It failed to show the slightest vibration. The right mixture of mud is far superior to cement mortar, because it forns a better bond with earth bricks.

In moist sedge meadows bordering the middle Rio Grande, the natural vegetation consolidates the surface soil into a firm sod. The fields used for growing terron sod are reserved for that purpose alone, and not even grazing is allowed.

It is said that a young lady visiting a fur farm once asked: "How often can a fox be skinned?" The same question arises regarding a terron field, but the answer is different. After a layer of terrones has been removed, it usually takes about ten years for the plant growth to produce a sod suitable for another crop of terrones.

Indians of the Rio Grande valley probably originated the use of this unusual building material. Isleta Pueblo, fifteen miles south of Albuquerque, is constructed of terrones. Situated on a knoll beyond reach of floodwaters, the one-story houses



▲ BENNY GARCIA, an Isleta Indian, the only full-time terron cutter in the country. He uses the primitive spade method, though several part-time cutters have devised effective homemade machines that are dragged behind a truck





Barnes and Caplin photos from *Western Ways*

◀ CLOSE-UP of the operation. The broad-leaved plant is *Anemopsis* (yerba mansa); the narrow-leaved ones are *Juncus* (rush) and *Distichlis* (salt grass). These blocks will be used at Isleta Pueblo and Albuquerque

▼ NATURE'S GIFT to the Southwestern housebuilder: terrones stacked for seasoning



seem as permanent as the ground with which they blend so harmoniously. There is no reason to doubt that the oldest Isleta houses were standing when Coronado explored New Mexico in 1540—400 years of continuous use!

During the nineteenth century, terrones were more commonly used than any other building material in the Río Grande bottomland villages and farms of central New Mexico. The wall of a barn north of Albuquerque, built about 1850, contains exceptionally large terrones. These can scarcely be called "bricks," as they are blocks of root-bound earth 22 inches long, 14 inches wide, and 9 inches thick. Two men were needed to cut and lift one of these giant terrones, and the structures built of them were massive and durable. This barn wall withstood the disastrous flood of 1874, which swept away buildings made of adobes and ordinary terrones, although terron houses are much more resistant to floodwaters than adobe houses. During the summer following this flood, some of the Spanish residents moved to higher ground and founded a new village, East Alameda, built of terrones cut from a near-by meadow.

Among the early Spanish inhabit-

ants, a young man about to be married had no housing worries. It was customary for him to build a terron house for his bride, adjacent to his parents' home, using one wall of the latter as the starting point for the new dwelling.

Up to a point, the best terron houses are those built most slowly. Since terron walls inevitably settle somewhat, the builder should allow time for this as the walls go up. After each five or six tiers of bricks, he waits a few weeks before proceeding. Perhaps this helps explain the popularity of terron construction, as this leisurely building pace seems to suit the charming regional temperament.

Nails driven into a terron hold

firmly and do not damage the brick. This makes possible a novel method of applying plaster, whereby stucco netting may be dispensed with. The terron wall is densely studded with roofing nails before being plastered with modern stucco. However, an even simpler method is often followed. A mud "plaster" is applied over the terrones with no preparation; the projecting roots and dead grass tops serve to hold the plaster satisfactorily. Most owners replaster every three or four years. A good workman achieves a most pleasing and appropriate finish with his humble medium by relieving the plane surface with a network of broad, shallow fissures. The effect reminds us





Alton A. Lindsey photos

▲ THE SKELETON of a terron is the firm mass of interlacing roots. All soil can be removed from the brick by soaking, washing, and kneading, yet the plant material will still hold the form of the original block

of the broad bark-plates of an aged western yellow pine and suggests that the house, like a tree, has grown up from the ground itself.

Plastering the outside is principally for the sake of appearance. In the dry climate of this region, there is scarcely any weathering of terron walls. Even unplastered adobes, which wear away a great deal faster, lose but one inch in twenty years, and this only where they are not protected by eaves. Many terron homes in the country, and most barns, are left unplas-

tered. It is often possible to tell at a glance, while driving past, whether the bricks are terron or adobe. This is due to a color difference, the high organic content of terrones making them darker brown, on the average, than adobes. And if one stops to examine the house at close range, there need be no question which it is. A terron house shows the roots and rhizomes, and often the grass tops, in the inverted bricks.

The use of sun-baked bricks in arid lands of the world goes back

▼ A RUSH PLANT removed from a terron which had been held firmly together by many such rootstocks and roots. The stout horizontal stem tunnels the sod

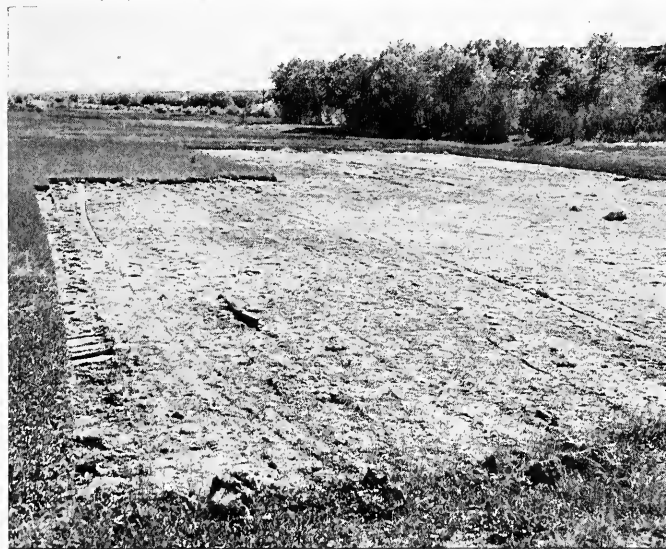


to antiquity. To express the height of impracticability we say, "like making bricks without straw," and true to tradition, workmen in our Southwest invariably add straw in mixing adobe. Yet modern engineering tests have proved that the addition of straw or any other organic matter really weakens the adobes. Tests in a material-testing laboratory showed that straw decreased the compressive strength of the resulting adobes by 52 per cent! There is some temporary advantage in its use, however. At first straw apparently helps to hold the soft, moist brick together during handling and drying.

The strength of sod bricks is perfectly adequate for the one-story houses typical of New Mexico. Rarely, one sees two-story structures built of terrones. Compression machines show that the average terron is capable of withstanding a pressure of 194 pounds on each square inch of its surface. This is about equal to the average strength of adobes, which are three times as costly.

◀ AFTER the top six inches have been removed for building blocks, Nature will automatically provide a new crop of bricks in about ten years

Barnes and Caplin photo from *Western Ways*





Barnes and Caplin photo from *Western Ways*

◀ WINDOW CASINGS are built right into the wall. After laying five or six tiers, the builder allows them to settle for a few weeks

The grass roots tie each terron together so well that an old terron building can be dismantled by prying the bricks apart with a crowbar. They remain undamaged and can be used again in a new house. This does not hold for adobes, however; they are completely ruined during removal from an old wall.

The best terron plants are those that spread by underground rhizomes and have profuse finely-branched root systems. Of all the plants in terron fields, salt grass best combines these requirements. Its horizontal subterranean stems, sometimes several feet long, have tough, sharp buds that can punch their way through hard adobe soil. Most of these rhizomes form a dense network in the uppermost three inches of soil. It would be hard to exaggerate the thoroughness with which salt grass roots and their myriad root hairs permeate the sod. The grasses are notable for the great branching of their fibrous root systems. An investigator found that one grass plant had roots with a total length of 357 miles! On these roots, this plant had about fourteen billion root hairs.

Another plant occurring in terron fields is the small rush, *Juncus*,

whose massive rhizomes are beset with the bases of upright stems. The tiny spike rush makes up in numbers what it lacks in size. A few other sedges and grasses assist in building terron sod. The most conspicuous plant in these moist meadows is the least important one, the yerba mansa. This member of the lizard's-tail family has large white flowers and broad, plantain-like leaves. Its stolons creep along over the surface, and its thick vertical roots weaken rather than strengthen terrones.

Vegetation takes much longer to build usable terrones on a light sandy soil than on one with much silt and clay. In fact, a pure sand could probably never be sufficiently rootbound. Although underground stems develop remarkably, the small roots cannot become abundant.

Terron plants would perish if dependent on the eight-inch annual rainfall. They are all sedge meadow species with high water demands. During the six months of the growing season, a given area of salt grass loses twenty-four inches of water to the atmosphere. This is four times as much water as the same area receives from precipitation.

The water table is found high in the soil, where it is in balance with the water level of the adjacent Rio Grande. Both the river water and the alluvial soil of the bottomland have high salt concentrations. From the water table, moisture carrying dissolved salts rises through the soil pores by capillary action. When it reaches the soil surface, the evaporating water leaves behind the salts which form a so-called "white alkali" deposit. This contains the chlorides and sulphates of sodium and magnesium. Few plant species can survive such a high concentration of soluble salts, which makes it more difficult for the root hairs to absorb water. But the salt grass and other terron plants are especially suited physiologically to flourish under these conditions. The cells of ordinary plants are largely unable to absorb these salts; consequently, the salt solution around their roots draws water out of them. In contrast, the plants native to alkali flats and salt marshes permit the chemicals to enter freely through the cell membrane, which tends to balance the inner with the outer concentrations. Their inner tissues actually taste salty. In this way terron plants not only avoid losing their body water from the roots but are capable of absorbing the additional moisture they need.

The popularity of terron construction has declined greatly in this century, except for a brief boom during the recent war years. Due to the scarcity of other materials, many terron houses were built then, by families representing all three of New Mexico's population groups.

Years ago many Spanish-Americans made their living by terron cutting, which has since dwindled to the world's smallest minor indus-



*Barnes and Caplin photos from Western Ways*

try. An Isleta Indian, using the primitive spade method, appears to be the only remaining full-time turrón cutter. The sight of him plying his archaic trade along the highway mystifies tourists, and they often stop their cars to find

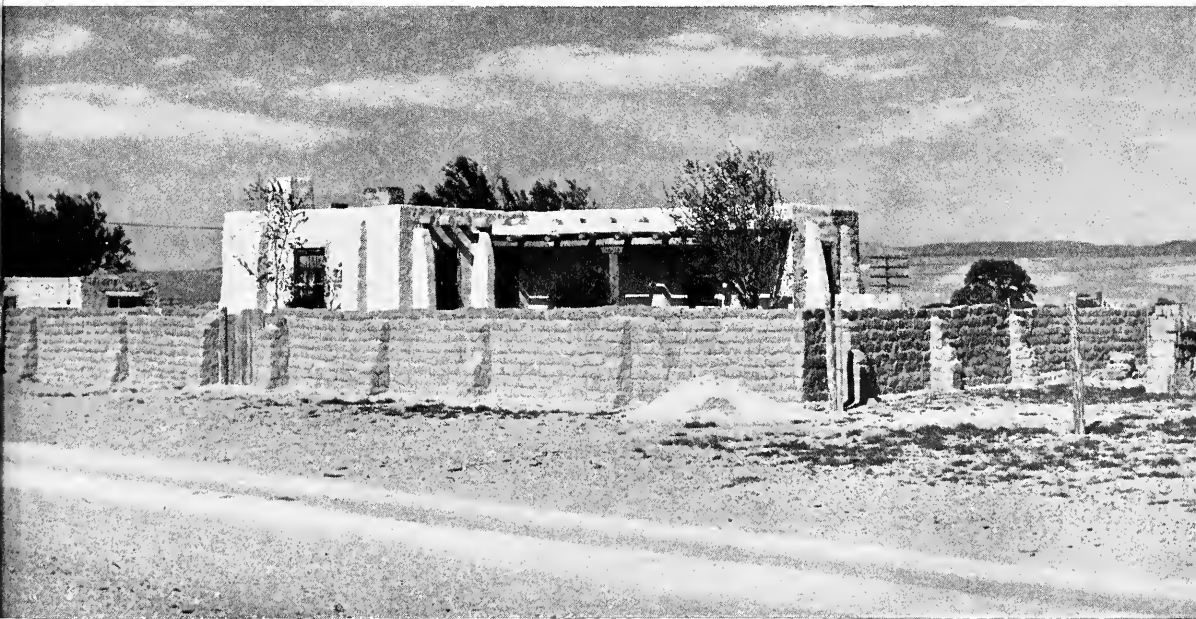
out what on earth is going on.

Most of us, on seeing our first unplastered turrón house, are inclined to feel scorn for this inex-

◀ MUD is used for mortar. Such a wall withstands rain and flooding better than adobe

pensive native material. This attitude is quite unjustified. Many large, modern turrón houses, finished with stucco, are not recognizable as being of turrón construction. No houses are cooler in the hot New Mexico summer or easier to heat comfortably in winter. It does not follow from these facts that earth is really a good insulator. Inch for inch, earth bricks have inferior insulating qualities when compared with wood and most conventional materials. But because of the very much greater thickness of turrón or adobe walls, they give the greatest year-around comfort. From this standpoint, as well as availability and economy, the turrón, in its proper setting, is a splendid natural building material for people "living close to the soil."

▼ A ONE-STORY HOUSE in Isleta Pueblo, New Mexico, built entirely of turrónes. The wall has been left unplastered





# Gulls

## over Santa Monica Bay

What man is earthbound,  
when a crumb for a bird can  
build a ladder to the sky?

By RUTH DUDLEY

*Photographs by the author*

**S**EA GULLS are a common but  
ever lovely sight over Santa  
Monica Bay in Southern California,  
especially in the late fall and winter.  
You see them resting on the shore,  
their shadows glistening on the





*Toss a bit of bread into  
the air and they deftly  
catch it on the wing*



dampened sand, or soaring gracefully through the clouds, their sun-lighted wings widespread.

The California Gull with its gray back and wings and bright yellow bill is a prominent coastal visitor. The slate-backed Western Gull and

the pearl-gray-backed Herring Gull are much in evidence, too, as is the red-billed Heermann's Gull.

In the summer many go inland to nest, so they're not so much in evidence. And since their food seems quite plentiful, they're more

content to go their busy way. But from late fall through spring they grace our coast with their beauty, depending on small fishes for the mainstay of their diet. And when fish aren't too plentiful, they're eager, indeed, for any nourishing bits their many human admirers toss to them.

Go down to the shore with some food scraps and you'll soon see a beautiful sight. They'll probably spot you coming and circle around and around, curious to see what you have, eager for your offerings.

Toss a bit of bread into the air. Watch them spy it at once! In they come, circling cleverly, swooping gracefully. Deftly they catch a bite in midair or dart swiftly to snatch up stray morsels that drop to the sands.

Their wings make a soft rustling sound overhead as they jockey for position just above you. Their bright





*In they come  
swooping gracefully...  
And more  
and more of them*

eyes, ever alert, miss no tiny crumb. Closer and closer they come. They almost dart down to take bread from your hand—almost—but they're not quite sure of you yet. Perhaps tomorrow they will be.

Bread eaten, away they sail—away and away into the California sky. But if you linger there at all, if there's anything left in that sack, they're not fooled. Circling back over the seashore, they are instantly at hand to seek more—and more—and more.

It's a beautiful thing to see—the grace of these gulls—over Santa Monica Bay in Southern California.







So completely  
is the mole adjusted to life  
in his lightless labyrinths  
that he  
even goes through  
the motions  
of digging in his sleep

# Little King of the Underworld

By TOM MCHUGH

*All photographs by the author*



THE sod cracked and heaved upward. First one side and then the other of a small ridge were pushed up. Nothing stopped the work of this subterranean earth-cleaver as he forged on through the soil. Stalked plants fell over on their sides and small roots were torn apart with a faint crunching sound.

My curiosity could wait no longer, and I quickly plunged a trowel through the ridge to trap the animal in the blind end of his tunnel. But even that was not enough to corner him. By the time I had brushed away the top of the ridge, the only remaining sign of the creature was a patch of velvety fur and a little pink tail. I rapidly seized the tail and started pulling, but pulling on that organ was about as successful as trying to uproot a small tree—it just didn't work.

Finally, by removing all the earth

▲ NATURE'S LITTLE "SAND HOG" depends on broad flat forefeet and strong claws. His eyes are almost useless. Kathryn and Byron Jackson have interpreted him as saying "... Night or day, rain or shine, it's all the same in a life like mine"

around him, I succeeded in pulling out all seven inches of a gray furry mass. With its broad, spadelike feet and pointed pink snout, it gave every indication of an animal that was truly "king of the underworld." Few animals have become as specialized for a narrow existence as this common mole.

Putting the mole on a hard-surfaced dirt road was ample proof of this. Completely ill-adapted to walking above ground, he traveled over the road with an awkward waddling gait. The ungainly stride was obviously due to the fact that his legs extended out to the sides, rather than beneath him.

When I placed him on some looser soil, he immediately sought a path of escape. Rather than waddle off into deeper grass, he quickly put his nose to work at

finding weak spots in the ground. Placing his forefeet close to his snout, he pushed the earth aside. Again his nose became active, not in boring or in shoving aside the dirt, but in discovering a suitable spot to place the feet for the next side stroke.

In less than a few seconds he had completely vanished from the upperworld and its attendant bright colors and pleasant breezes. He had disappeared into a world of damp earthy smells, perpetual darkness, and sounds little stronger than the weak grating noise made by an earthworm inching along through its tunnel. The mole's life is one of blind confinement.

Like most animals that dwell in undying darkness, the mole has very poor eyes. Scarcely the size of a pin head, each one neverthe-

less contains all the elements of a normal eye. But most of these elements have greatly degenerated, and the mole can probably do no more than tell lightness from darkness.

In the lightless chambers of his underground home, however, the mole needs no vision and no apology. With his naked snout and small pink tail he perceives the earth about him. Both structures are densely covered with sensory cups and tactile hairs. Running from these to the brain, a network of nerve trunks conveys the vital messages. When the mole is backing up in his burrow, the tail serves like an eye in the back of his head. In going forward, the nose is never used for loosening the soil. Rather, it makes rapid and detailed examinations in order properly to direct the powerful claws.

Of course, the mole's ears are also very valuable sense organs. Since big external ears would rapidly become clogged with dirt, the mole has none. Instead, two little skull holes lead into inner organs of hearing that are powerfully developed.

Besides the ears, nose, and tail, other modifications adapt the mole

to its subterranean life and complete the story of this remarkable specialization. The fur is velvety and offers scarcely any resistance to the animal's passage within the tunnels. The neck is so short that the forelegs seem to sprout from the sides of the head. With this arrangement, the mole can bring his forefeet together in front of his nose for excavating earth from the end of the burrow.

The big, flipper-like forefeet are the very essence of his moleness. The claws of the forefeet are broad and spadelike, and in digging they are pushed against the earth like so many shovels. Compared with the rapid digging of an animal like the dog, the mole is slow indeed. Unlike the dog, the effectiveness of the mole's claws is not due to the momentum gained before they strike—rather, it is due to the great muscular force with which they are pushed. The large size of the forefeet makes them an adequate base for the enormous claws and gives them a large capacity for transferring piles of loose earth. Even the hind feet are webbed to kick earth through the tunnels.

Although these adaptations have been known for some time, their

exact method of use for digging was long a mystery. Since moles do not expose themselves at the surface while burrowing, field studies could give only general ideas concerning the animal's movements.

Naturalists long believed that the mole could easily "swim" through the earth, much in the manner that a person glides through the water by the breast stroke. It took some clever experiments by Dr. F. L. Hisaw to prove that "swimming" was not the usual case.

Dr. Hisaw constructed boxes with glass sides and bottoms so that the burrowing creatures could be watched from the side and from below. In this way he found that progression was, to be sure, made by a swimming motion if the soil was loose. But if the soil was packed until it was as solid as that normally found in nature, the mole did not "swim," but dug.

The digging is done entirely with the forefeet. The way in which these are used can be demonstrated by placing a mole on a table and holding it down with the palm of the hand. The mole might be expected to resist this force by raising its body and struggling out, but it

▼ A MOLE HILL like this at the surface indicates where the mole has been digging a deep tunnel and has pushed the dirt up into a pile

▼ If you poke a stick into a mole hill, you will find a soft place into which the earth falls to the tunnel system below. The mole later plugged the hole shown here



does not. Instead, it rotates its body, puts one forefoot on the table and the other against the hand, and pushes with a slow but strong motion.

Moles use the same type of movement when they are excavating their surface runways. One foot is placed on the floor of the tunnel while the other pushes the earth up to form a ridge. The sod is thrown up on the right and then on the left and in front. There is every appearance of industrious work as the mole presses forward at the rate of about 12 to 15 feet an hour.

Besides these surface runways, which are used for collecting food, moles also dig deep passages that are used as headquarters and for thoroughfares to feeding grounds. The deep tunnels may be from six inches to two feet below the surface of the soil.

At this depth the earth cannot be pushed upward or to the side. Instead, it must be loosened and carried away. After a quantity of dirt is freed and piled in the tunnel behind the mole, the animal turns about and pushes the earth out of the burrow with one of its broad paws.

▼ A SECTION has been cut through the surface runway to show how the earth has been split and pushed up to form the tunnel



▲ AN AVERAGE MAN would have to lift 4800 pounds to equal the strength of a mole. It can exert 32 times its body weight in this position, with forefeet thrust against the thumb and fingers of the hand

As the soil is forced up through the entrance, it falls down on all sides and forms the familiar mounds that we call "mole hills." Sometimes this earth may be packed into a discarded part of the tunnel system.

Like most people, moles eventually become discontented with their homes and begin remodeling. Whereas human beings rebuild their houses for better appearance, the mole does so for food. As the mole remodels, he drives a new tunnel beneath the old, pushing the earth into the discarded burrow above.

This seems to be a clever way of saving labor. The remodeling is obviously for the purpose of feeding on earthworms and insect lar-

vae, which require moist earth. If the animal were to construct an entirely new system deep enough to reach this food, he would not only have to break the hard dry surface but would also have to remove much earth to reach the proper depth.

Since these tunnels are a vital defense against predators from the outer world, breaks in them are rapidly repaired. Soon after a rupture occurs, a little pink snout appears and cautiously explores the opening. The snout is quickly withdrawn, and, within a minute, the break is plugged with a mass of soil.

Moles even use their digging habits to capture dangerous prey. They have been known to force

(Continued on page 383)



◀ MOBILITY is inherent in the entire equipment represented in this camp at Lockerbie, near the northern tip of the Cape York Peninsula. George Tate is seen at work on his collection under mosquito netting. The bicycles were useful in collecting where roads or paths existed.

By

L. J. BRASS

All photographs by Archbold Expeditions

# Camps on Cape York

Fortune and misfortune in Australia's northern no man's land: vignettes conveying the true essence of expedition life

CAMPS are more than temporary stopping places to the expeditioner. They are important focal points in the memory of those who travel off the beaten tracks. One does not, in retrospect, go directly back to the mountain ridge where some new plant was found or to the exact spot where a rare mammal was trapped. It is from camps as local points of orientation that the mind's eye carries one back over the trails of the years. That is so with me, at any rate.

On the Archbold Cape York Expedition in the spring and summer of last year, we lived in camps as varied in associations as they were in kind. We camped by the sea and on the mountains, in the sodden gloom of rain forests and in fire-swept open country. Some of our temporary homes had such unorthodox amenities as floors underfoot, a stove for the cook, and even a shower bath with running water. Others were thoroughly primitive and had little to recommend them for comfort.

The most wretched camp on the trip, and I think in the whole of my experience, was high on the east slopes of Mt. Bellenden-Ker, more than halfway to the 5200-foot summit. We found its name, Tick Camp, not at all fitting, when with two local men, Bill Kerns and Sven Nielsen, Dr. George Tate and I climbed the mountain in April and stayed there two memorable nights.

*"Water, water everywhere . . ."*

● We knew that mountain would not be easy. We had been told stories of men who had cracked up on the long climb and had to be helped to Tick Camp and water. The Bellenden-Ker area, with 160 inches of annual rainfall on the coastal sugar-cane lands below the mountain and perhaps well over 200 inches at high elevations, is the wettest part in all Australia. Moisture-demanding rain forests cover the slopes and formerly occupied most of the now cultivated lands below. But so rapid is surface runoff on the very steep sides of the moun-

tain that lack of water is a difficulty expected by the occasional parties that make the climb. The only sure camping supply within 3000 feet of the summit is at Tick Camp. There, clear cold water can be dipped from pools in the granite sand of a gully head crowded with graceful *Orania* palms and tree ferns.

Scarcity of water would not be one of our troubles, we felt, as we set out from the cane cutter's barracks we were using as a collecting base. The weather had been rainy. Streams coming down from the mountain had roared in spate every night; and early that morning, for the first time in four days, we had seen the main peaks exposed through the white clouds that had been hanging over the summit ridge. If we had any misgivings, they were about our gear, which I'm sure would not have been approved by an expedition outfitter back in New York. Most of our equipment was on a ship strike-bound down the coast, and we were making shift without it. We

➤ A "GAMMON" SHOWER approaching on the strong southeast wind that blew day and night at Newcastle Bay. The camp was situated on the sand dunes behind the low trees at right

▼ CROSSING the peninsula toward Newcastle Bay, the truck became stuck in a boggy gully. The fallen tree was one of many blown down by a cyclone



▼ GEOFFREY TATE and some butterflies he caught at Newcastle Bay. He collected reptiles and amphibians, as well as insects and other invertebrates



had no tent or fly, nor could we have carried one in any case. Food, bush knives and a tomahawk, cameras, a blanket, and a change of clothing apiece were as much as we could tote, besides papers and boards for collecting plants. George and I were rather proud of packs we had fashioned from "Sugar Mixture" fertilizer sacks found in the barracks. Bill had his Australian army pack and ground sheet—relics of the New Guinea campaign. Sven carried his things in a 70-pound sugar bag—the Australian Bushman's holdall. Both wore the shorts and shirt that are practically uniform garb in that tropical part of the country, and for ease of travel, Swen went barefooted.

Starting out along grassy head-

lands of the cane fields, we entered the deep shade of the rain forest by a path slashed through a bordering raspberry thicket. Then, after crossing a little stream where we paused to cut helping sticks, we began to climb by a faint old trail marked by stubs of cut undergrowth and here and there by a blaze on a tree.

#### The Bamboo Zone

● The first 1400 feet of slope was very steep and hard going. Footing was bad on a clayey soil left wet by the rains. The morning sun, quickly gaining strength and shining on the treetops, set up hothouse conditions in a forest much entangled with lawyer vines and a climbing bamboo. Lawyer vine is

a name facetiously applied by Australians to climbing rattan palms of the genus *Calamus*, the thin stems of which are used for cane furniture. From their prickly leaves hang slender thongs of tendrils armed with hooks as unyielding in their hold on clothing or neck or ear as the grip on clients of the fabled gentlemen of the law. The inch-thick green stems of the bamboo, hanging from the trees and sprawling in loops on the ground, were nuisances in other ways. They made a perfect slide when trodden on unwarily. When cut, their sharp ends often caught our shins or whipped

across the trail to snag our packs.

Above the bamboo zone the forest became fairly open underneath and the gradients temporarily less steep. The sky by this time had clouded over, the air had become cooler, and we had gotten our second wind. There were places where the big white flowers of a rubiaceous shrub filled the forest with a delightful, gardenia-like fragrance. This shrub occurred only on the crest of a spur ridge, where, with increasing altitude, a mat of exposed surface roots formed a soft brown covering on the ground. Traveling a bit farther, we stopped at a trickle of water in a gully to boil the tea billy and eat lunch. We had climbed about 2000 feet.

Mist now hung in the treetops, quieting the birds, which up to then had been busy and noisy enough, though not conspicuous. In the stillness, broken only by the soft crackling of our fire, the moving things of which we were most conscious were leeches. From a safe seat on cut leaves of a fan palm, which the blood-hungry pests could not cross without being seen, we watched them standing on end, an inch or two high, on the leaves and twigs that strewed the ground, leaning and wavering sensitively in our direction and looping their way toward us.

Early on the climb, Sven and Bill had often stopped to scrape one off a foot or a leg with their knives, then grimly bisect its extensible and remarkably tough, dark body against a tree or rock. George and I, with trouser bottoms stuffed into tops of socks, and legs well rubbed with carbolized soap, were not so much bothered, although all four of us were bleeding somewhere from the attentions of the loathsome things. One had been discovered

as it attached itself in a corner of my mouth. Another had crawled into my shirt and escaped notice until I felt an itching, burning sensation under my right arm, where oozing blood was slowly coagulating. Investigating at my belt line, I found the enormously distended leech that had dropped off after its feeding. The blood from the bites was kept flowing for a time by a secretion from the mouth area of the leeches, which retards coagulation—and attracts other leeches. Sven's bare feet were a horrible sight by the time we stopped at the lunch camp, and Bill fared only slightly better. The tender skin of a war wound on one of his legs was a favored place for attack.

#### Tick Camp

● So far, apart from the annoyance caused by leeches, we had done well enough. But as we shouldered our packs to go on, rain began to fall—cold rain that soaked us through and added weight to our poorly protected loads. No one had much to say, even about the increasing leech pest, until the end of a hand-and-foot struggle that brought us to the crest of the main southern spur of the mountain at 3100 feet. From there on, up and down along the narrow crest, the going was easy, and I was glad

of it. My legs were beginning to give out when a dim shape, with horizontal lines blurred by rain, showed ahead in the forest, and Bill inquired, overcasually it seemed to me, "What do you think of it?"

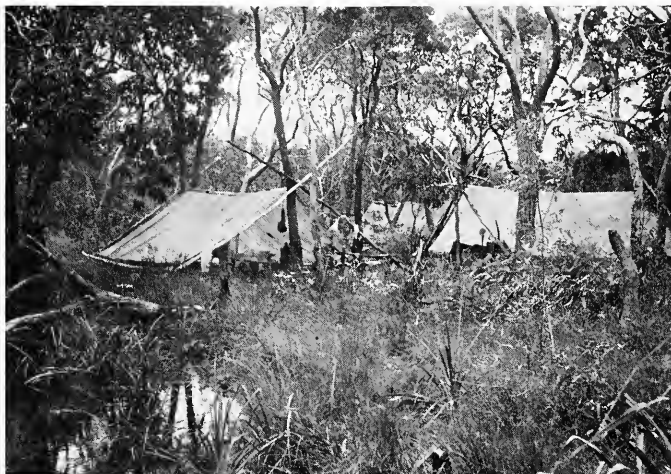
There was nothing imposing about Tick Camp. If conditions had permitted me to take a picture of it, you would have seen just a few patches of charcoal where campfires had burned, a rusty can or two, and an open, very leaky little lean-to shelter thatched with palm leaves. The shelter stood in tall forest and faced out over the edge of a precipitous slope that dropped off into the clouds. Bill and Sven had built it on an Easter visit two weeks before. The poles of its frame were tied to living saplings with split lawyer cane, and a few still green leaves lay spread on the ground for a floor.

In the pelting downpour, our guides went after more palm leaves to enlarge and improve the shelter, while I started to light a fire. Under the roof, a stick of green ghittoe had thoughtfully been left hanging. Ghittoe (*Halfordia scleroxyla*) is a tree of the rue family, common in the mountain rain forests. Green or dry, its timber, bushmen swear, will burn under the worst conditions. This would not. Nor would dead ghittoe. I split the yellow, oily

➤ HOBART VAN DEUSEN serves dessert at Newcastle Báý. Joe McLaughlin, the cook, is on his left and George and Geoffrey Tate across the table.







◀ CAMP by a quiet water hole in open forest near the Jardine River, on the far northern part of Cape York Peninsula

▼ THE EXPEDITION lived in this World War II radio hut at Iron Range. The thick rain forest in the background was rich in plant and animal life

wood in slivers thinner than a match and arranged them above the wet ground on flat-split billets. Still it would not burn. Wooden safety matches, carried in my oiled-silk tobacco pouch, would strike, but that was all. Their stems would not burn as kindling, nor would so-called waterproof wax matches, which would not even strike. The fibrous inside of rotting lawyer canes, which the rain forest aborigines use for starting fires, was tried without success. Newspaper from the plant presses took up moisture so rapidly that the paper itself would not ignite, let alone set fire to the wood. And the rain kept pouring down. It dripped and trickled through the roof of what was now a fairly roomy hip-roofed shelter, with eaves down to the ground. It drifted in the ends of the shelter as ground spray, and water seeped up from the trodden, peaty soil.

Of necessity, the fire-making job became a problem for all hands. Wet, chilled to the bone, tired, and constantly pestered by leeches, we tried every trick we knew. Our puckered hands shook so with cold that it was hard to strike a match or arrange the slivers under the drip-proof shelter of Sven's wide felt hat. Finally, after efforts lasting a full two hours and a half, by means of a bit of waxed paper that George remembered he had



in his pack, we got a fire going. And when it did burn, it filled the shelter with pungent, choking ghit-toe smoke, which drove us out into the rain to wipe streaming eyes and gasp for breath.

"And so to bed . . ."

● A fire inside, big enough to keep us warm in the night, would have shriveled the palm-leaf roof with its heat and let in all the rain. So, revived by hot tea and a meal of bread and canned beef, we set about building an extension to the shelter—a "skillion" in Australian parlance. The fire soon drove off the leeches, and we sat dozing before it well into the night. When the downpour slackened a bit, we spread wet blankets on wet palm leaves and turned in. Lightweight plastic-coated nylon raincoats were a boon to George and me. We could not travel in

them, but worn over our wet clothing they kept the wind out. Worn over dry clothing while we slept, they retained our body heat and saved us from being soaked by water that dripped from the roof.

At dawn, the rain looked as though it would never stop. But we had food enough for only another day, and weather had to be disregarded if we were to achieve our objective of examining the upper levels of the mountain. We wanted to compare the ecology with that of the mountains of New Guinea and of lower mountains on the Cape York Peninsula, and to collect plants which so far as is known occur only on the top of Bellenden-Ker. One of my side interests was the collecting of seeds of Meston's mangosteen, endemic on this mountain and reported to have a fruit quite good to eat. I had been asked to obtain seeds for

experimental planting and cross-breeding in Florida.

Trivial though it now seems, changing back into clothing that was not only half wet but befouled by smoke from hanging in the shelter seemed even more of an ordeal than the subsequent certainty of a cold drenching and more leech bites, and we lingered at the fire to warm the sorry garments before doing our changing.

#### Elfin Woods

● On the 2000-foot climb that morning, the rain forest of tallish, straight trees, in which I searched unsuccessfully for the mangosteen, reached close to the summit. There it gave place to montane cloud forest, very different in character and largely so in floristic make-up. This was the well-named elfin wood of tropical mountains—gnarled, crowded, stiff, often misshapen small trees, at most sixteen to eighteen feet high, heavily mossed on stems and branches and deep in moss on the ground. Soft moss cushions, absorbent as bath sponges, dripped amber drops of water they could not hold. The rain was almost sleety up there. Shifting, swirling mist limited vision to a few yards, giving an eerie effect in such surroundings and producing

the curious, padded silence peculiar to mountaintops when the mists are down.

Wooroonooran, the aboriginal name for Bellenden-Ker, has an apt natural suggestiveness for the summit as we saw it. It is perpetuated in the name *Leptospermum wooroonooran*, by which botanists know a striking, umbrella-topped tree that grows bigger than any other in the elfin wood. Another remarkable tree found nowhere else is the tree heath *Dracophyllum Sa-*

*yeri*, with bell-shaped pink flowers and long narrow leaves that sheath the branches. We searched in vain for the beautiful red flowers of Australia's only rhododendron, *Rhododendron Lochae*, which grows on this and a few other northern mountaintops. The only really colorful things were big salmon-pink slugs, conspicuous on the leaves of trees and apparently well adapted to conditions that were anything but congenial to us.

Six hours after leaving it, we



▲ PACK HORSES were used in the rough mountain country. This resting place is surrounded by casuarina trees, "oaks" to Australians because of the grain of their wood

➤ FROM BONANZA CREEK CAMP, on the headwaters of Archer River, gear and supplies were carried on pack horses to camps on the McIlwraith Range

◀ WILLIE, Mr. Brass's native assistant, on the rocky heights of Tozer Range

were back at Tick Camp, preparing for our second and last night in its drippy shelter. This time we made sure of more comfort, though the rain kept on and there were itchy new leech bites and inflamed old ones, about which we could do nothing. More leaves were put on the roof and more on the ground, and there were bundles of plants for pillows. Only three inescapable drips disturbed me—one on my feet, one on my body, and one that splattered beside my head. Such was our experience in a mountain haven that others had named for a pest we did not see.

### Happier Days

● One of our most pleasant camps was in the Mossman River Gorge, 60 miles north of Bellenden-Ker, where we lived under good conditions in rich rain forest that was a naturalist's Eden. As guests of the caretaker of a small hydro plant, on a do-for-yourself basis, we had the use of electrical cooking appliances and a telephone, as well. There were delectable pineapples, bananas, and papayas from Jim Cobb's garden; and there were hot-tish days, during which Geoffrey

Tate wielded his butterfly net in the clearing or went with me into the forest to collect more humble insects in moss and under stones and rubbish, while I gathered plants. Clear, cool water rushed between great granite boulders in the river, not far from a slowly swirling, almost emerald-green pool in which we swam at midday. On still evenings, Hobart Van Deusen, after setting his traps, would take gun and head lamp to hunt tree-dwelling mammals of nocturnal habits and shy rain forest wallabies, which go by the name of paddymelon. There were only we three of the nine men who made up our full party on the more northern parts of the Peninsula.

Our farthest camp of all was on Newcastle Bay, less than nine miles from Australia's northernmost point, the tip of Cape York Peninsula, and only a hundred miles across the island-studded Torres Strait from territory that George and I had worked in New Guinea on a previous Archbold expedition. It was rigged in the shelter of low, wind-clipped trees on sand dunes immediately behind a broad, open beach, with the kitchen fly and

George and Van's mammal department on one dune, Geoff and I on the next, and the tent of our three blackboys on a third. Little streams, heading in a boggy hollow where pitcher plants grew and running among pandanus trees where they passed between the dunes, provided water somewhat peaty but good to drink.

Day and night, a strong southeaster blew without letup, sifting sand into our tents and our food or driving showers in from the sea and back over the land. These frog showers, or gammon showers, as they were called, would perhaps be the only rain for months, for this was May and the wet season had ended several weeks before. We were in territory in which (except on and about the higher mountains, of which Bellenden-Ker is an example) the year is divided into well-marked wet and dry seasons. Good rains would probably come from thunderstorms in November, but the big rains of the northwest monsoon would not arrive until about the New Year.

### The Pattern of Life

● This climatic rhythm, with rainfall enough to support rain forest in the most favored situations, and a long dry season well suited to drought-resistant grasses and trees in the drier localities, prevails both in northeast Australia and parts of neighboring south and southeast New Guinea. There is geological evidence of direct land connections between the two areas in times since the evolution of modern plants and animals. It is therefore not surprising to find, in large areas of New Guinea having pronounced wet and dry seasons, a *Eucalyptus* and tea tree (*Melaleuca*) type of open forest vegetation typically Australian in character, inhabited by characteristic Australian birds and Australian mammals such as wallabies. Nor is it surprising that trees and other plants with origins in the Malaysian center of plant distribution, of which New Guinea is a part, should comprise much of the rain forest flora of northeast Australia, and that in



these rain forests should be found riflebirds and the cuscus, representing New Guinea faunal groups.

These are examples of only some of the gross aspects of the complex pattern of plant and animal distribution in Australia, New Guinea, and the great Malay Archipelago lying between Australia and Asia. These and other origins, distributions, and relationships are established as far as materials for study and present understanding go. Three Archbold expeditions to New Guinea contributed much to knowledge of the fauna and flora of that rich island area. It was the need for more materials for study—both collections and observations on environments—that took us to the Cape York Peninsula, on the biological highway between Australia and New Guinea. In its northern parts especially, little is known of the plants and of most groups of animals.

#### Rough Travel

● Newcastle Bay Camp was reached by crossing the tip of the Peninsula by an old disused road that passed through rain forest as well as open forest of bloodwood (*Eucalyptus terminalis*) and tea tree. The wet season had left the grass high, obliterating the road in the open forest; and a cyclone had cluttered much of the area with fallen trees. In the open forest, most of the down timber could be dodged by detouring through the long grass. In the dense rain forests there was nothing to do but to clear the road or cut a new one with axes and machetes. With a driver more timid than Dick Holland, who did our transport there, or a truck less sturdy than his war surplus four-by-four, the last eight miles would have taken more than the five hours in which we did it. Dick drove over everything the truck could climb, knock down, or crush with its weight. And that rough trip yielded a very good collection of spiders and insects, shaken down on the mixed load of baggage and men.

An unusual way of acquiring specimens? Perhaps. But nothing

to approach Van's shooting of the marsupial flying mouse, *Acrobates*, on a night hunt from Newcastle Bay Camp. Van shot into a flowering bloodwood tree. The animal fell and he lost it in the grass. Next morning, mindful of flesh-eating ants, Van visited the spot bright and early. A long search disclosed nothing but a python, coiled under a log and bulging with something it had swallowed. Van had found his *Acrobates*, but the tiny creature was not the cause of the bulge. With it inside the snake was a bandicoot, a somewhat piglike, small, ground-inhabiting member of the great diversified group of Australian marsupial mammals of which the largest and perhaps most widely known, are the kangaroos.

As the dry season advanced, we moved south in stages, examining the rain forests of the wetter areas, the tracts of dry, scrubby vegetation known as turkeybush, and the open forests or savannas that cover most of the country and are burned over almost every year after the grass dries. With us then was Donald Vernon, of the Queensland Museum, collecting birds and mammals for his institution. He was always an energetic helper in such community jobs as setting up and dismantling camps. Our culinary department, very important on a long expedition, was in the care of Joe McLaughlin, an old-timer on the Peninsula and a friend of everyone.

#### Scattered Settlers

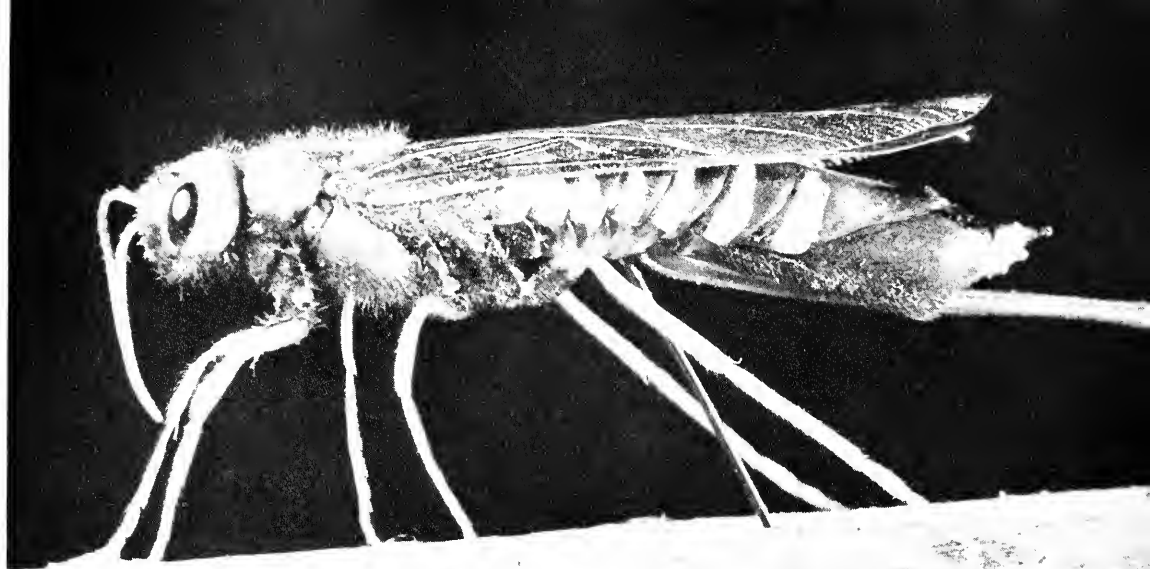
● It was a vast country, very thinly inhabited. In a few areas, miners of gold and tin and cattle ranchers lived, sometimes with their families, in the isolation of the outback. Few of the aboriginal natives roamed their old hunting grounds. Most of them were gathered at missions on the coast or were working for white men. Our shifting community was one of the main centers of white population on the upper Peninsula. Coen township, the largest center in 350 miles, had only 25 voters.

At Iron Range we lived in a building that Americans knew as the radio station of a big military

airfield in World War II. Mostly, our camps were what we made of them, with tents and flies, a minimum of portable furnishings, and ingenious improvisations on the part of Joe. Sometimes we slept under the open sky, not troubling to rig unnecessary shelter but putting up mosquito nets to keep off the dew. There were few mosquitoes to bother us in the dry season and not much risk of malaria. Leeches would not be much in evidence again until the wet season and then only in rain forest localities.

Some of our camps were beside the rough, two-wheel-track roads we traveled by truck. Others, up in the mountains, were reached by pack horse train or by cutting trail and carrying all the bare essentials ourselves. Homes were hospitably thrown open to us wherever there was settlement, and the splendid pioneer womenfolk were liberal with dainty eatables, which Joe, with his simpler grocery stock, could not achieve. There were also feasts of our own contriving, as when fresh vegetables and fruit reached us from the monthly boat that plied the coast or when Joe cut chops and roasts from a fat wild porker brought in by one of the black-boys. The boys, cooking their share in their own way, sang a contented corroboree down by the creek. Fresh meat always was an event. It meant a change from the dry-salted beef that hung for keeping on the poles of the tents and, with good yeast bread baked in a camp oven, was the foundation of most of our meals.

For us each day brought events—things new to the collection, something fresh to discuss, successes, disappointments—for not every day was, or could be expected to be, a good day for all of us. But as time goes by, most of the days will lose identity as days. There will be a sorting and arranging and synthesis of our recollections of the Peninsula. And the rearrangement will be largely a grouping by the camps that were our living places and the centers of our activities.



▲ HORNTAIL drilling in tree trunk to lay eggs

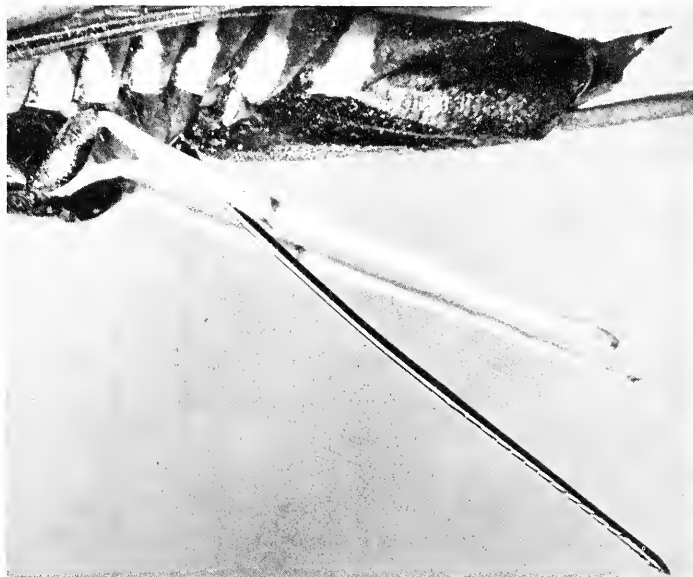
▼ CLOSE-UP showing the ovipositor of the horn-tail

# Drillers OF THE INSECT WORLD

By LYNWOOD CHACE

**I**NSECTS are frequently equipped with finely fashioned tools that can do just as complete a job as any of the best made by man. Here the horn-tail is shown at work, drilling a hole in the trunk of a tree by means of a drill and ovipositor that extends from the insect's abdomen. Into this hole, approximately half an inch deep, the horn-tail will deposit her eggs. The highly magnified view below shows the nicety with which nature has designed this implement.

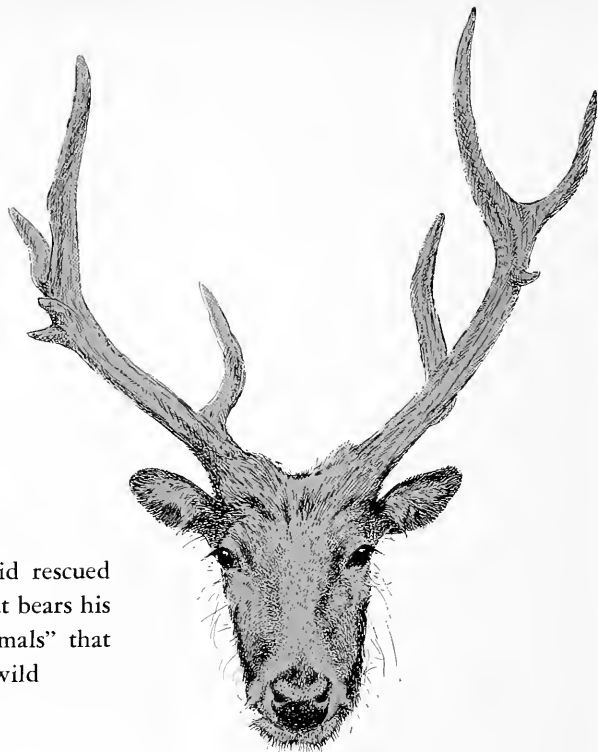
Mechanically amazing as this im-



plement is, the situation is perhaps more astonishing from the philosophical point of view. One might suppose that such a difficult and ingenious method of laying eggs would guarantee security for the future generation of young horn-tails. But not so. If an insect be-

longing to one of several species of *Thalessa* happens along, it will locate the larvae of the horn-tail beneath the bark by methods no one has ever explained. Then, with a drill approximately three inches long, it will proceed to lay its own eggs in the horn-tail's larvae!

# The Story of the Milu



Almost a century ago, Père David rescued from oblivion the curious deer that bears his name—one of the few “wild animals” that has never been seen in the wild

By WILLY LEY

“MY preparations for the journey were completed several days ago, and I can start out by about the end of February. Because of this intention, I hurried to have my last shipment for the Museum packed; it consists of the skins of mammals and birds and a few live plants which I have entrusted to the intelligent care of Monsieur Alphonse Pichon, attaché of the French Legation, who is going to return to Paris.”

These lines were written in the city of Peking in 1866, and the writer was a French missionary who was an enthusiastic and well-informed collector of animals, plants, and geological specimens. His name was Armand David—Père David at the time he wrote these lines and Abbé David after his final return from China, where he had traveled for the first time in 1862. The contributions of the naturalist-missionary to the natural history of the Far East were numerous and varied, but his fame rests mainly on a discovery he made just before he started to write his diary. The nature of this discovery

is disclosed in the lines of his diary immediately following those quoted above:

“The principal item in this shipment is the *Sse-pu-hsiang*, a kind of large reindeer of which the female is antler-less. For a long time I have tried to obtain a specimen of this interesting variety of the *cervidae*, still unknown to naturalists, which I know to exist in large numbers and for centuries in the Imperial Park *Hué-Dze*, a few Chinese *li* to the South of the capital.”

Father David's name for the park is not the one used by sinologists, but there is no doubt about the locality to which he referred. Several miles south of Peking was the Imperial Hunting Park, called *Nan Hai-tzu*, which at the time of Father David's visit was considerably larger in extent than the city itself. The area that later became a park seems to have been a kind of hunting or pleasure ground for the emperors of China for many centuries, but most of the time it was more or less open ground. It was probably walled

in about 1400; in any event the wall was centuries old when Father David saw it. Needless to say, nobody was permitted to enter the park, especially a foreigner.

Having heard that animals were kept inside the park under the guard of soldiers (mostly Tartars), Father David decided that he would at least look at them, even though there was no way of wangling permission to enter. Early in 1865, he climbed the wall and saw several game animals he knew well. But he also saw a large herd—he estimated it at 120 head—of a big staglike animal that he had never seen before. He was also certain that no other naturalist had seen it, and it naturally became his ambition to record this unknown animal in the catalogues of science.

His diary contains some information that must have been supplied by native friends. He learned that there was a death sentence awaiting anybody who dared to kill one of these animals. But he also learned that the Tartar guards violated that law themselves on occasion, when their menu grew too short or too



monotonous. Nevertheless, their fear of the law was strong enough to prevent them from selling anything that might be evidence; they would neither part with a skin nor with the bones or antlers. As regards the latter, there was a slight exception; Father David reported that the insides of the antlers resembled ivory so much that pieces (presumably after the outside had been ground off) were sold as ivory and transformed into various utensils by Chinese craftsmen.

Father David also learned the Chinese name of the animal, *Sse-pu-hsiang*. This means "not like four" or, more elegantly, "four dissimilarities." It is supposed to express the thought that the animal does not look like a stag, a goat, an ass, or a cow. Later the deer

was often referred to under the more handy name of *Mi-lu*. This, however, was not known to Father David. In any event, he did what he could to obtain some evidence concerning this strange creature for the Museum in Paris. He probably repeatedly postponed the trip he wanted to make into the interior just for this reason. But for a long time his quest remained, to use his own term, "unfruitful."

At long last, in January 1866, he got two complete skins *en assez bon état* (in passable condition), possibly by devious methods, which he unfortunately did not record in detail. Shortly thereafter, the French Legation obtained three more *Sse-pu-hsiang* through the good offices of the Imperial Minister *Hen-Tchi*. These, alas, did not sur-

vive the trip, but Alphonse Milne-Edward in Paris had material for the first scientific description.

As is customary, the first describer had the privilege of proposing a scientific name, and Milne-Edward chose *Elaphurus davidianus*. In English-speaking countries, "Père David's Deer" has become the usual appellation. This is nice in that it honors the discoverer, who might have had to pay dearly for his scientific curiosity. But it is not quite so short and simple as *Milu*, which is the common name on the continent.

Even at first glance, Père David's Deer appears to be a peculiar creature. In size, it is rather large; a full-grown stag will stand four feet at the withers, about the same as a red deer. But its general carriage is quite different, a fact that has not always been known to taxidermists who mounted specimens. Instead of carrying its head high like a deer, the *milu* usually carries it low, more like a cow. The whole attitude has been termed "slouching" by Lydekker. The tail is unusually long for a deer and is equipped with a hairy tassel like that of a donkey. The animal has both neck and throat manes. It has rather large, wide-spreading hoofs, which fall together with a loud, clicking noise when it walks slowly. The antlers are especially strange. They are large and look at first glance as if they might have been put on wrong. The main fork curves forward, dividing at least once. The hind prong, which is undivided, is very long and is directed backward in a way that is unlike any other antler known.

Usually only one young is born, in May. The fawns are heavily spotted with white, but as the animal grows up, the spots vanish. The females seem to retain them a little better than the males. The adults have a grayish-red coat in summer, which shades to whitish tints on the underside. In winter the coat is a grayish-buff. The call of the adults is more a bray than the typical call of deer.

After Milne-Edward's description had appeared in the *Comptes*



From Richard Lydekker's *The Deer of All Lands*

▲ COMPLETELY EXTINCT in the wild, Père David's Deer is happily represented in several zoos. During wartime restrictions, half the Woburn Abbey herd starved, but it has provided the London Zoological Society with seven and the Bronx Zoo with four. Four others will go to Australia soon

*Rendus des Séances de l'Académie des Sciences* (1866, page 1090), where the name Milu is used for the first time, the directors of all zoological gardens had a brand new dream—to acquire and exhibit a pair of milus. The various legations in Peking suddenly received instructions concerning zoological matters, and they were usually successful on a small scale. After all, the Imperial Hunting Park was not actually used for imperial hunts, and Père David himself had pointed out that he had been told that no hunt had ever taken place there.

In 1869, two live specimens were presented to the Royal Zoological Society of London by Sir Rutherford Alcock, and in 1883, the same Society bought two more in China. One specimen arrived in the Berlin Zoological Garden, where it lived unhappily and lonely for many years and indoctrinated many Berliners with the belief that "stags in China look like that."

The Duke of Bedford, father of the present Duke, decided to add the milu to the collection of rare animals in his park at Woburn Abbey. He bought all the milus that could be bought anywhere. It was at Woburn Abbey that a surprising discovery was made: the milu sometimes sheds its antlers twice a year, instead of once!

While the heads of zoological institutions were still dictating letters to Peking, the milus of the Nan-Hai-tzu Park suffered a catastrophe. In 1895, the Hun Ho river caused a disastrous flood, which sentenced thousands of peasants to death from starvation. The same flood also undermined the ancient brick wall of the park, and many of the animals enclosed there, including the rare milus, escaped and were killed and eaten by the starving populace.

Still, it cannot have been the end of the whole herd. Some must have survived, because it is reported that "the Imperial Hunting Park was thrown open in 1900 and all the deer in it killed by the International troops." In 1901 only one milu, a female, still existed in Peking. It stayed alive until 1920.



New York Zoological Society photo

▲ ONE OF THE BRONX ZOO'S MILUS, with the first fawn ever born in the Western Hemisphere. Its white spots will disappear with growth

This was the last Chinese milu, for the major mystery surrounding this animal is that it has never been found in the wild anywhere. When Père David saw the large herd from his place on the brick wall, and when his discovery was reported in Europe about a year later, most naturalists began to wonder about its normal distribution. None were known from the reasonably well-known areas of China near the coast, so its habitat must probably be found in the interior. The possibility that it was otherwise extinct and had survived only in the park did not occur to anybody. The natural assumption that there had to be wild milus somewhere was apparently strengthened by reports of travelers who told that native guides, especially from the northern parts of China, had told them about occasional small herds of Sse-pu-hsiang. But all these reports were mistaken. The guides really meant reindeer; and this was dramatically demonstrated in 1904 when a hunt undertaken by Chinese netted eleven Sse-pu-hsiang that were to be shipped to Woburn Abbey. Ten of the eleven died during the journey to the coast; the eleventh proved to be a reindeer. Some entries in Père David's later diaries must be founded on the same mistake. It is important to note that Père David never saw any

of the animals he was told about.

Possibly native Chinese, living a considerable distance from Peking and knowing nothing about the real milu, took the term "four not alike" and fitted it to an animal they knew, the reindeer.

Regarding the original habitat of the milu, there are two theories. One is that it was brought to China by the Manchu. This idea, however, while somewhat romantic in tinge, has nothing else to recommend it. In fact, it may refer, through these mistaken reports, to the reindeer. The other is that the milu's original home was on the large plains of Chihli Province, which in former centuries were immense reed-covered swamps. As agriculture advanced, drainage of the swamps and cutting of the reeds gradually left the milus homeless, so that they dwindled in number and finally survived only in the area that became the Imperial Hunting Park.

A precise parallel to this can be found in the fate of the European bison or wisent, which also roamed over most of Europe when the continent was still covered with dense forest. It receded with the forests until it finally survived only in an Imperial Hunting Park—the famous forest of Białowiec, not far from the spot where before the First World War the three empires of Germany, Austria, and Russia met.



New York Zoological Society photo

▲ IN THE VELVET. Père David's Deer withstands cold well. Even the growing antlers do not seem to suffer frostbite

In fact, the parallel goes so far that the largest number of pure-blooded wisents still alive are now at Woburn Abbey, too.

The idea that the milu preferred such areas as the former swamps of Chihli Province is also bolstered by observations of the Woburn Abbey specimens: "In England during summer they are very partial to water, often wading out as far as they can go and sometimes swimming; at this season they feed largely upon water-plants, especially rushes. The long and widely expanding hoofs, which form one of the characteristic features of this species, are evidently adapted for walking on marshy ground." (Lydekker, 1901.)

After the destruction of all the Chinese milus except the one female, most living milus existed at Woburn Abbey, about twenty of them at that date. It can be said right now that the story has a happy ending; there are today more than 240 milus in England.

An inquiry about the growth of this herd and especially about win-

ter care of the animals was kindly answered by the present Duke of Bedford. In a letter dated April 15, 1949, His Grace informed me that the number of milus at Woburn Abbey as of that date was 242—45 stags, 119 hinds, and 78 last year's calves of as yet undetermined sex.

"Eighteen Père David's Deer were originally imported from various Continental zoological gardens," continued the Duke of Bedford, "but of these at least three never bred, so that the present herd is descended from not more than fifteen animals. By the end of 1913, 137 had been born, 47 had died and 35 had been killed owing to old age or disease, and one had been sent away. During my father's life-time, I think, only two stags were sent away, one to Karl Hagenbeck in Germany and one to the London Zoological Gardens. During the summer of 1914, 20 calves were born, and there were 88 animals in the herd. During the First World War, however, quite half the herd perished of starvation, as the authorities insisted on sheep and cat-

tle being turned into the Park and did not allow enough hay to be provided for winter feeding. I had to put up a great fight to prevent official folly from having similar disastrous consequences in the last war."

In resistance against winter weather, the survivor from Old China has proved rather hardy.

"The deer here run in the open Park, where they have access to open-fronted sheds, which are used a good deal by the adult animals, but rarely by the young ones. The sheds are unnecessary from the standpoint of giving protection from the cold, as the deer are able to stand very severe weather, and even the growing antlers of the stag do not seem to suffer from frostbite. . . . The only artificial food that is necessary in winter is hay, but of this there must be an ample supply. If there is any shortage and the young animals are allowed to get into a low condition, a number are lost from parasitic worms. Unlike most deer, Père David's do not care for the branches or fruit of trees, nor do they eat turnips. Apart from grass, the only natural food for which they show any fondness is certain water plants."

Since the herd is now so large, it has been possible to restock zoological gardens from Woburn Abbey. A total of seven animals have been given to the London Zoological Society, but through the natural course of events there are now eight. Likewise, New York received four and now has five, a fawn having been born on April 10, 1949, the first birth in the Western Hemisphere. During this year, four milus will be shipped to Taronga Park near Sydney, Australia, and four to Dr. Heck in Munich, in exchange for Mongolian wild horses (*Equus przewalski*).

In the course of time, more and more people in various corners of the world will be able to see a milu again, discovered not quite a century ago near Peking. Extinct in nature and almost extinct even in captivity, it was saved at a time when to any sane observer the case must have seemed hopeless.

# The SAND-HILL CRANE *Still Calls*

ONCE heard, the far-reaching call of the sand-hill crane is a sound that never can be forgotten. The notes roll out like a ratchet on a giant pulley, though not without a certain vibrant, musical quality. And when a group of these great birds fly over with their clattering notes of song, the impression is startling. A flock of cranes on migration, flying follow-the-leader fashion high in the sky, leaves no uncertainty as to their identity, for they never fail to sound their char-

Reminiscent of the broad unspoiled wilderness, its distinctive cry and the pattern of its wings against the sky will always thrill the fortunate observer

By HENRY H. SHELDON

*Photographs by the author*

acteristic notes, which can be heard from one to three miles away.

One of my early impressions of the sand-hill crane came while on a survey of the big Bad Lands of South Dakota. No great wilderness is

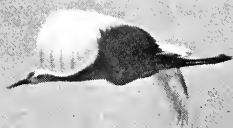
more profoundly desolate and silent than these badlands; so when a flock of sand-hill cranes gave voice, I thought I had never heard any bird notes so beautiful and satisfying. The sight of them a mile high was equally inspiring, and as the late naturalist Vernon Bailey so aptly described them, "I watched their southward flight until all was gone but the sound of their magnificent voices."

During the first settlement of the white man in Oregon, sand-hill cranes were abundant; in fact, even as late as the first years of the present century, a flock of a hundred or more was not an uncommon sight. But today the sand-hill crane is considered a rare bird over its entire range, which extends, in the breeding season, from Canada to California and as far east as South Dakota and even Michigan. The mountain meadows and marshes of the western states are its natural nesting haunts. In the fall it leaves them to migrate south to Mexico and Florida.

Those who stick to the paved highways will not see these big

✧ JUST HATCHED. A day later, the other chick emerged. Sand-hill cranes build their nests in the water, as a rule in a swampy meadow near a jungle of cattails where the young can seek safety





▲ A PAIR of anxious parents that came close but changed their minds about landing

birds, and assuredly they present a sight worth viewing. Usually a high-powered binocular will be necessary if you want to watch them feeding. They eat frogs, snakes, grasshoppers, field mice, and, in fact, almost any creature that can be subdued by their powerful beaks. A meadow mouse that dares to course its runway is snapped up in a flash, sometimes flipped into the air, caught, and swallowed with the aplomb of a juggler. Cranes are also fond of a variety of vegetable matter, including grains, but they do not often do any great damage to grain fields, because it is their habit to avoid association with man.

During the breeding season, which begins in April, the cranes stage a courting dance which, from the accounts of those who have been fortunate enough to observe it, must be a most spectacular and amazing sight. S. S. Visser's description has been called the best account of this performance. Briefly, the great birds, perhaps 20 or more, gather at a chosen site on some high piece of ground where they can command a view in any direction for half a mile. They begin by raising their heads to their extreme height, then bowing low. After repeating this several times, they begin bouncing like feathered balls, leaping over one another with wings half spread. The speed increases as

new flocks fly in to join, and after an hour or more the dance becomes a wild frenzy.

Many species of birds perform these nuptial antics of courtship, but my imagination tells me that these cranes, standing four feet high from toe to beak, could put on a show to outdance anything else in the bird kingdom.

Most people unacquainted with the general features and characteristics of the crane confuse it with

the great blue heron, which is often wrongly referred to as a crane. As the two birds belong to widely separate orders, they are obviously quite different. However, one not up on birdlore might easily be uncertain whether he saw a heron or a crane, especially if the bird were standing at a distance. Both birds are blue-gray in color, and though the crane is the larger, distance and light alter the apparent size of all creatures. In such an instance, be-



➤ THIS LITTLE FELLOW was lost temporarily. Its plaintive call was a weak whistle, but the parents heard it and came





▲ A PAIR OF CRANES near the nest, apparently unaware that the cameraman was hiding nearby in the sagebrush

havior would be the sole means of identity. Once on the wing, there is no mistaking either bird. The crane flies with neck and legs stretched full length, while the heron pulls its long neck into the feathers of its breast and resembles the crane only in its outstretched legs.

Despite the crane's isolated habitat and its wary nature and habit of feeding in open areas where its keen eyesight prevents any foe from too close approach, it is dangerously decreasing in numbers. The chief

cause is the encroachment of civilization upon its comparatively restricted haunts.

Up on the Malheur National Bird Refuge, which runs parallel to the Steens Mountain Range for some 30 miles, 90,000 acres have been fenced. This great area comprises a variety of terrain suitable for the propagation of such precious species as the sand-hill crane, trumpeter swan, American egret, glossy ibis, and others. This is just one of several of Uncle Sam's bird havens

that have been set aside for the protection and preservation of our wild fowl.

Here the sand-hill crane is in its chosen element—an expansive meadowland, watered by streams that issue from the alpine Steens Mountains and flow eventually into the great Malheur Lake and marshland. This avian paradise had always been home for the cranes, and thanks to wise and farsighted conservationists, it remains their refuge indefinitely.



# A Tree with a Maltese Cross

By MARIE COPELAND

NATURE does some queer things, but almost everyone who sees this section of a tree agrees that it is one of the strangest oddities he has ever seen. As the photograph shows, the tree contains a well-nigh perfect design of a Maltese cross.

Two hunters were tramping the timbered foothills of the Rocky Mountains in western Montana when they paused to rest at the foot of this yellow pine. Its peculiar shape — like a four-leaf clover — caught their eye. Returning later with a crosscut saw, they felled the tree and found that the curious cross extended the entire length of the tree trunk. Much of the tree, however, was rotten and was discarded by the finders. The trunk was about fourteen inches in diameter.

So perfect is the outline of the cross that at first glance one asks: "Is it inlay work made by man?" But Nature's "inlay" is more real and convincing than any handiwork man could create. Each tiny line, indicating a year's growth of the tree, is easily traced completely around the face of the block. In the center or heart the grain forms a convincing replica of the all-seeing eye, similar to that used in the emblem of Masonic Lodges.

The cross is now a part of the writer's collection at Yakima, Washington, among numerous other northwestern curiosities gathered over more than a quarter of a century.

What force could have disturbed

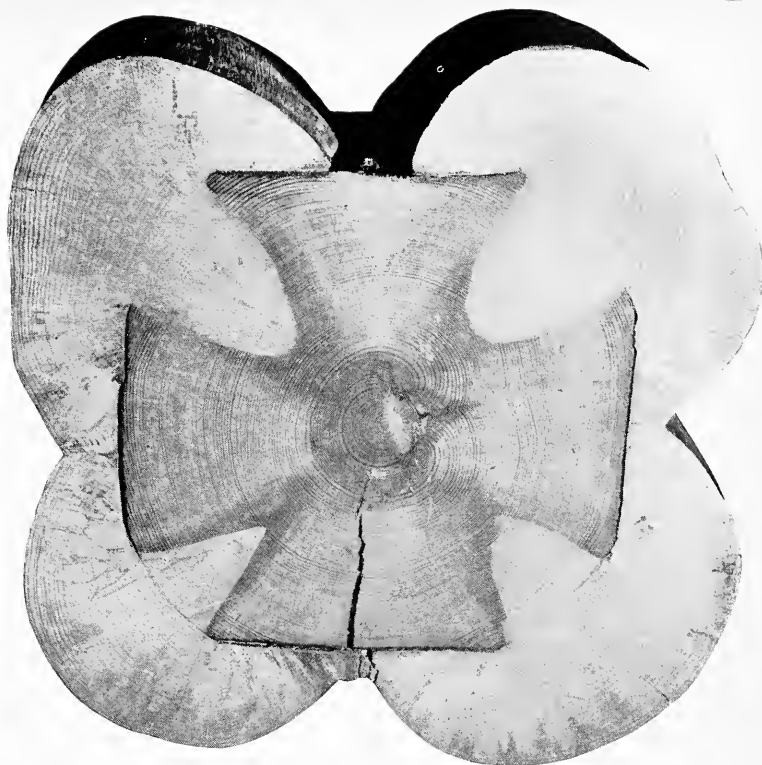


Photo by Willard Hatch

this tree to produce such an unusual formation? Was it struck by lightning? Did the winds blow? Or was it stricken with some dread tree sickness? Many persons have pondered over this question, but perhaps the best answer is offered by Dr. William M. Harlow, of the New York State College of Forestry. He writes as follows:

"This is without doubt one of the most interesting tree sections I have ever seen. Although at first the pattern may seem unexplainable, a careful study of the ring growth makes clear what happened to the tree. The 'eye' effect near the center is not unusual and has resulted from some injury, perhaps a fire scar, when the tree was quite small. Notice how the rings cover the scar and eventually join again to form complete circumferences.

"Now, look at the top of the cross and notice that a similar condition has developed along the flat surface shown. On the other three faces the new wood has completely covered the scars. What caused the scars? It seems likely that this tree was blazed on four sides to mark it, per-

haps for land survey purposes. The Maltese cross consists of heartwood; the rest of the cross section is sapwood. Although even the sapwood of this pine, as well as that of other trees, consists largely of dead, empty cells (in this case tracheids or 'fibers'), it does contain a certain amount of living tissue, namely the wood rays, and living cells around the resin canals. When these living cells die, heartwood formation is said to take place; and at this time various chemical substances may be deposited, which usually make the heartwood darker than the sapwood. When the tree was blazed, heartwood formation was initiated earlier than normally would have occurred, because all the living cells from the cut faces were deprived of radial communication with the cambium and bark. This accounts for the curved 'bay' between each two faces.

"If this explanation does not satisfy the reader, he can easily test it by actually making a 'four-square' set of faces on a living tree and observing the results over a period of years."

Bering Sea and the North Pacific, where they prowl in relentless search of prey. They are the most ferocious of marine animals, able to swallow seals and the smaller porpoises at a gulp, and even to kill the true whales. The Eskimos in their skin boats have great respect for the Killer Whale and avoid any encounter with it.

### **Insects that Outwit Carnivorous Plants**

SIRs:

Dr. W. H. Hodge made out a most interesting case for the plant kingdom in his article on "Carnivorous Plants" in the June NATURAL HISTORY. The inference would certainly be that insects must be very stupid if, in spite of having brains and eyes, they let mere plants overcome them. But not all insects deserve this opprobrium. For example, the water in a pitcher plant leaf is a fine aquarium, full of microscopic food particles, and the pitcher plant mosquito takes advantage of it. This insect by-passes the downward pointing bristles by flitting into the open throat like a helicopter, descending to lay eggs on the water surface, then rising to escape again. The wrigglers that hatch from the eggs feed on the microorganisms that congregate over the drowned bodies of other insects. Each wriggler tosses itself to the surface film and presses a breathing tube through to the air above. Its gullet squeezes the pitcher plant water from each food particle before the food enters the stomach. And apparently no significant amount of the digestive juices secreted by the plant leaf enter the mosquito wriggler's skin, since it lives on, grows, pupates to a bullhead and finally emerges, to fly away to the open air beyond the pitcher's throat. But only one kind of mosquito—*Wyeomyia*—makes use of the pitcher pond in this way.

Sometimes the pitcher plant mosquito gets caught by another inhabitant of pitcher leaves—the pitcher plant spider, which spins a net across the open pitcher and catches insects going in either direction. The web is hung across the lip of the leaf, and the spider spins a silken life line on which to descend toward the water. But during rains, spider and web may both be swept into the pitcher, where the former drowns and becomes food for the plant just as does a bird's egg or a cube of meat placed in the water.

Several kinds of flesh flies—relatives of the common blow flies—also take advantage of the pitcher plant's food collection. From a safe landing strip where take-off again is easy, one of these flies will deposit its living maggots high up on the plant. The maggot slips down the hairy throat, falls into the water, but is at home immediately. The decaying insect bodies



▲ PALE MAGGOTS, fat and well fed at the pitcher plant's expense, operate at the bottom of the vase-like leaf, scavenging the depths of the trap for the drowned decaying bodies of insects and spiders. Given time, these would emerge through a hole in the pitcher's side and become flesh flies. The pointed end is the head. Two dark spots toward the opposite extremity are air pores, which the maggot brings to the water's surface at intervals for breathing

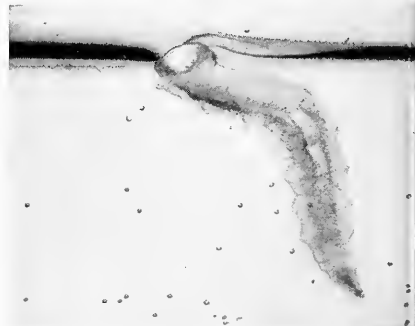
shown in Dr. Hodge's photograph are perfect food for the scavenging maggot. And for air it merely extends its body until the hinder end is at the water surface. Respiration occurs through a pair of fancy air pores surrounded by water-repellent hairs. The maggot grows as it uses up the plant's collection of drowned insects. Finally it bores a small hole through the pitcher wall, wriggles through to freedom, and pupates for transformation into the parent type of fly.

Farther south, where pitcher plant leaves have umbrella tops that keep out excess water in heavy downpours, a solitary wasp has taken the habit of cutting a hole near the pitcher bottom to drain it completely. Then it brings in straw and leaves to build a nest in which to rear its young. The pitcher plant still can use such a leaf for synthesizing foods in sunlight, but the protein-catching, water-holding feature is gone for good.

◀ WRIGGLERS OF THE PITCHER PLANT MOSQUITO are found only in the water collected in pitcher plant leaves. In this very restricted niche they thrive on microscopic animals and plants, which in turn derive their nourishment from the decaying insects the plant leaf has caught. The wrigglers are immune to the digestive juices secreted by the leaf



▲ THE PITCHER PLANT SPIDER spins a web across the throat of the leaf and catches insects as they slide toward the depths of the trap. It snares still others (such as the Pitcher Plant Mosquito) as they emerge like helicopters from the liquid below. The net photographed here shows indication of having been broken and repaired at least once—probably when some insect fell through and was caught by the plant



▲ THE MAGGOT OF A FLESH FLY makes its way to the surface and opens to the air above a large cup-shaped cavity, from which breathing tubes lead downward throughout its body. The aquarium water in which this specimen was photographed was saturated with air, as evidenced by the small bubbles on the glass wall. However, this carnivorous animal has become so used to life in a poisonous environment that it absorbs nothing from it other than decaying food material

All of these are ways in which potential prey make use of the carnivorous plant for ends that do the plant no good. Perhaps careful observation will yet reveal some insect or spider that steals the sticky drops from sundew and puts them to some special use. Or some animal of small size may be found that specializes in stealing the insects from a Venus's-fly-

trap or through the trap door of a bladderwort. Once we found caddis cases in a pitcher plant leaf, suggesting still other and yet unknown inhabitants of insectivorous plants. No doubt those that can watch these interesting and unusual kinds of vegetation more closely can add greatly to what is already known of them.

LORUS J. and MARGERY J. MILNE,  
*University of New Hampshire.*

Durham, N. H.

### **Tribute to the Dance**

SIRS:

The cover of your September, 1949, issue does credit to a sincere and talented young man. It is a real pleasure to see Redge Laubin receive such fine publicity. No one deserves greater credit for his complete, accurate, and warm portrayal of the life, the costume, and the dance of the first Americans. . . .

DR. CLAYTON G. RUDD.  
Minneapolis, Minn.

### **Friendly Raccoons**

SIRS:

As a member of the American Museum of Natural History of many years standing, I take the liberty of sending you the following account of a recent experience with raccoons, which may be of interest to your readers.

Together with two friends and a guide, I spent two nights this July at Inlet Camp on the Upper Anasable Lake in the Adirondacks. About 7 P.M. a young female raccoon came to the cookhouse porch. I

tossed her a flapjack, which she took immediately; then, of her own accord, she climbed onto the porch. All four of us were sitting only a few feet away.

It suddenly occurred to me that I might lure her still closer. I offered a bit of chocolate, and she took it at once. The next piece I held at my knee; and at the next, she had her front paws in my lap. At the next, she had all four paws up and was sitting contentedly in my lap showing not a trace of nervousness. This all happened in broad daylight while the four of us were talking in ordinary voices, and others were moving about getting more flapjacks and syrup for her. If we had had a camera, we could have taken innumerable pictures, as she stayed in my lap about twenty minutes and only left after all the food was gone. She had even licked my fingers for the final drop of syrup.

We were the first occupants of this camp this year, and the other near-by camps had barely been used. As she was a yearling, her experience with humans could therefore only have been as a kitten the previous summer.

The following night we were waiting for her, but instead a large male raccoon came, and the same performance was repeated almost exactly, except that he was so big that he could only get his front paws in my lap. Even so, his face was within eight inches of mine. His mannerisms and personality were totally different; he was aggressive, impatient, and determined, also completely without nervousness or fear, whereas the female was

gentle and unhurried. Neither animal had ever seen us before or had become familiar with our voices, scent, or motions.

Our guide and others with whom I talked all said that they had never seen or heard of anything like this. I know that raccoons are easily tamed, but I would greatly appreciate it if you would tell me if you have had other similar incidents reported.

Mrs. EDWARD CLARENCE DEAN.  
Byram, Conn.

The following comments are offered by Mr. T. Donald Carter of the American Museum's Department of Mammals:

Mrs. Dean's account is very interesting. On rare occasions, for no apparent reason, an individual mammal or bird will lack the accustomed fear and seek the society of humans. But it would seem very strange if two such animals should make their appearance at one time, and I would rather suspect that these raccoons had been associated with people at some previous time. The most logical explanation would be that they were either in captivity and had been liberated or had escaped, or that during the previous summer this family had been attracted to one of the camps, perhaps to visit the garbage pail. If animals are offered tempting food, they can be induced to take it from the hand. It does not take some animals long to learn how and where such handouts may be obtained. The fact that the first raccoon showed no nervousness is good evidence that the procedure was not a new experience to her.



### **LITTLE KING OF THE UNDERWORLD**

*Continued from page 365*

earth against the nests of yellow-jackets until the insects were completely crushed or smothered. The attacking mole then safely devoured both the young and adults.

The mole's adaptations have confined him to a life in lightless labyrinths. The round of his experiences consists mainly of smells of fresh moist earth, plant roots, and various worms and grubs he seeks out for food. Digging hangs so heavily

on his mind that he may sometimes be seen going through the motions of digging even in his sleep.

These earth-cleaving and feeding habits do not go completely unobserved, especially if they appear in the garden or on the golf course. Prized daffodils are felled, and key golf shots are shaken from their course.

Fortunately, there are two sides to the matter. Moles are injurious

only when they appear in concentrated gardens or in golf courses. Elsewhere they do a world of good by eating large numbers of destructive insects. In fact, just one mole can consume about 40,000 insects and worms each year.

Through the ages they have also played an important part in the evolution of the soil. By constantly moving and stirring it, bringing up subsoil, and carrying down organic matter from the surface, they have contributed to the natural building up of soil fertility.

With man's occupancy of the land the value of moles as cultivators ceases. Their natural process is much too slow. But in the uncultivated areas of the earth, the little king of the underworld still remains a useful citizen—the symbol of one of Nature's most complete and successful ventures into the realm of subterranean darkness.

**Winners of the Insect Cryptomaze** in the June issue of **NATURAL HISTORY**: The three contestants submitting the highest number of insects listed in the main section (A-Z) of *Webster's New International Dictionary—1948* (unabridged), in accordance with the rules of the contest, are: HAROLD EATON, Jackson Heights, N. Y.; DR. HENRY S. RICH, Bronx, N. Y.; DR. ELLSWORTH SMITH, Madison, Conn. Each of these winners has received a copy of *The Insect Guide*, by Ralph B. Swain, published by Doubleday and Company, Inc.

# MUSEUM ANNOUNCEMENTS

## *Is Indian Culture Oriental?*

Possible evidences of trans-Pacific traffic from Asia to North and South America long before the time of Columbus form the theme of an unusual exhibit titled "Across the Pacific?" which will be on display at the American Museum through October.

The exhibit is the first ever to assemble a wide range of varied materials showing striking similarities in the ancient cultures of Asia and the Americas. It does not attempt to prove that continuing contact occurred in early times but rather is designed to present some of the reasons why anthropologists are becoming more and more interested in determining whether the ancient civilizations of the Far East contributed to the development of American Indian cultures.

In art, musical instruments, weapons, and architecture, many marked similarities occurring in Asia and the Americas are displayed in the exhibit. For example, the totem poles of the Northwest Coast and similar monuments from the interior of Borneo are shown to be almost identical in many cases in both form and subject. It is now believed that this art style probably spread in ancient times from China to islands of the East Indies and Melanesia, and it is possible that the American Indians received it from the same source, either across the Pacific or around its shores.

Further interesting similarities are shown in the designs on vases and stone sculptures of the middle and late Chou dynasties of China and cultures of Mexico and Guatemala, as well as in the Buddhist and Hindu art of India, Java, and Cambodia. An unusual section devoted to musical instruments of South America and Oceania points out amazing resemblances between the Pampipes of Melanesia and Bolivia, the shell trumpets of Melanesia and Mexico, and the unusual nose flutes of the Philippines and South America.

Another high light of the exhibit is a display of head-hunter trophies from Oceania and South America. The human heads and skulls on display in this section show an amazing likeness in general treatment and in the way in which they have been decorated.

This theme constitutes one of the most fascinating riddles in the science of man's early cultural development. It is hoped that readers of *NATURAL HISTORY* will soon have opportunity to weigh the pros and cons in an article by Dr. Gordon Ekholm, who, with Dr. Robert von Heine-Geldern, supervised the preparation of the exhibit.

## *"An Artist Looks at Nature"*

A special exhibit of drawings, lithographs, and oil paintings by Miss Vera Andrus will be open to the public until October 18 at the American Museum of Natural History. The display includes some 40 pictures of shells, driftwood, flowers, and plants and will be based on the theme, "An Artist Looks at Nature."

Miss Andrus, a member of the staff of the Metropolitan Museum of Art and teacher for the City College of New York Adult Education Program, has prints in the permanent collections of the Library of Congress, the Metropolitan Museum of Art, and the Minneapolis Institute of Arts. Her first "one-man" show was held in New York in 1932, and she has since exhibited throughout this country as well as in Canada, South America, and Europe.

Miss Andrus is a member of the National Association of Women Artists, from which she received the medal of honor in 1941 and the members' print prize in 1949.

## *Native Dances*

Traditional ethnic techniques will form the basis for a group of exciting new dance works to be presented this fall at the American Museum of Natural History, in the series called "Around the World with Dance and Song."

The forthcoming dance programs will include a number of new artistic dance forms created within the framework of ethnic styles. The programs will demonstrate how strict adherence to traditional techniques need not limit dance creativeness or prevent artists from enlarging and molding certain ethnological materials into interesting and varied new dance patterns.

The new series, to be held in the Museum's main auditorium, will include an afternoon program especially adapted for children at 3:30 P.M. and an evening program given for adults by the same artists at 8:30 P.M. It will consist of seven Thursday programs from October 13 through January 26.

The fabulous American dance artists Ruth St. Denis and Ted Shawn will open the series on October 13 in a remarkable "Denishawn" program. On October 27, Hindu and Tibetan dance styles will form the basis for a program of fascinating, brilliantly costumed dances by Sujata and Asoka, accompanied by authentic native music.

"The Americas in Concert Dance," a group of gaily colored dances derived from the folkways and social forms of the American people, will be presented by

the Dudley-Maslow-Bales Trio on November 10. Included also in the series will be the exciting primitive dances of Claude Marchant, formerly a leading dancer in "Show Boat," and a group of vivid, skillfully conceived Spanish dances by Federico Rey and Pilar Gomez. The dances of Bali, Java, and Sumatra will be offered by Soekoro and Devi Wani and their Indonesian troupe.

For the final program of the series, the versatile and talented Hadassah will appear with her colorful new company in dances of the Orient and the Near East. Included in the program will be the powerfully moving "Shuvi Nafshi" and the lyrical, lightly humorous "Fable." There will also be a number of new works in the Israeli, Indonesian, and Hindu dance forms.

Further information can be secured by calling Mrs. Hazel Muller, at Endicott 2-8500, Extension 248. All seats are reserved, and orders for tickets will be filled in the order received.

## *Antarctic Skies and Telescope Making*

During October, audiences in the Hayden Planetarium will travel to the antarctic regions to enjoy the stars that circle over the South Pole. Beneath constellations that we never see in our mid-northern latitudes, they will become acquainted with the problems of time and navigation that have confronted our antarctic explorers.

A special fall course in telescope mirror making will begin on October 4 and 5 at the Hayden Planetarium.

The class, a combination lecture and laboratory session, is conducted jointly with the Optical Division of the Amateur Astronomers Association and will be held in the fully equipped optical and machine shop of the Hayden Planetarium. The course includes lectures on elementary optics and on the design, construction, and use of telescopes. Each student, under the guidance of a competent instructor, may grind, polish, and figure a six-inch telescope mirror. This Pyrex mirror for a reflecting telescope becomes the property of the student upon completion of the course.

Students will attend one night each week, either Tuesday or Wednesday, for 20 three-hour periods. The course is accepted for credit by the Board of Education of New York City. Further information may be obtained by telephoning or writing the Amateur Astronomers Association at the Hayden Planetarium, Endicott 2-8500, Extension 300.

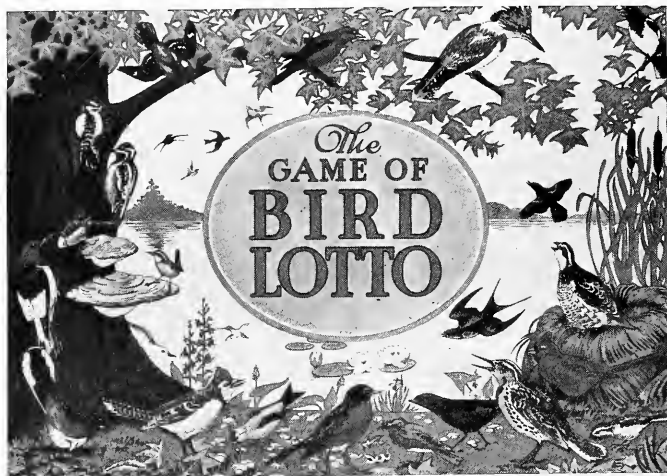


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# LETTERS

## Insects as Food

SIRS:

You may be interested in the accompanying photographs showing but one example of man's many uses of insects as food.

This Zapotec Indian near Oaxaca, Mexico, offers as an appetizer to accompany the drinking of alcoholic mescal, fried or toasted "caterpillar pretzels." He would call them *gusanitos del maguey* (little agave caterpillars). These are actually the larvae of one of the skipper butterflies (*Aegiale hesperiaris* Walker), which are found throughout the semiarid districts of Mexico. They plague the fleshy leaves of the several species of maguey (*Agave* spp.), an ever-present source of Mexico's popular and potent alcoholic beverages; pulque, mescal, and tequila. Instead of attempting the chemical eradication of these pests, the Indians long ago hit upon a better solution: they eat them! So popular are they that they may be found in most native Mexican

food markets and are even canned for the grocery store trade.

Like the writer, many a tourist has tried these *gusanitos* and has found them tasty and as appetizing as pretzels. For ease in handling, they are threaded into bunches and are individually salted when eaten (note small glass of salt). The individual pottery container at the left contains mescal.

Many aboriginal peoples throughout the world appreciate the food value of insects. Besides the Mexican Indian, I have seen Carib Indians dig out the juicy grubs of palm beetles and devour them with great relish. I have also seen highland Andean Quechua and Aymara with equal gusto hunting and eating "nutty-flavored" head lice.

Professor Essig, distinguished California entomologist, has recently summarized the nutritive value of insects in these words: "Great masses of insects are probably as nutritious and as wholesome as are oysters, crabs, lobsters, and even other types of meats ordinarily eaten by civilized human beings."

W. H. HODGE.

Amherst, Mass.

## Saved by a Porpoise

IN the October, 1947, issue of NATURAL HISTORY Magazine, Mr. George C. Goodwin of the American Museum's Department of Mammals discussed briefly the ancient legend that a porpoise will push a drowning person toward shore. Like a number of other stories about the behavior of animals, this belief seems on first sight to be almost too fantastic to be considered seriously. It has apparently been passed down from classical times, and seafaring folk have doubtless always been ready to defend the porpoise as the only animal that comes to the aid of a drowning man.

The porpoise is known to be an extremely inquisitive and playful creature. It will roll under and nudge to the surface any partly submerged object that is not too large. Furthermore, when a young porpoise in the tank at Marine Studios in Florida died during the night, its bereaved parent was found the next morning supporting the young one at the surface. This was interpreted by some as an effort to help the young one breathe if life yet remained.

We now have the following very interesting account from the wife of a well-known trial attorney residing in Florida. She prefers that the location and names be omitted, because the near-accident was at least partially the result of the inattention of the owner of the bathhouse where it occurred. The "porpoise" involved was probably a dolphin, in the opinion of Dr. Frank W. Preston of Butler, Pennsylvania, a keen student of natural history who induced the lady to write her account of the experience. Along these shores the word "porpoise" is frequently applied to animals that are, strictly speaking, dolphins. Dr. Preston forwarded the account to Dr. J. Kenneth Doult of the Carnegie Museum of Pittsburgh, who in turn sent it to NATURAL HISTORY Magazine. We print it verbatim, as follows:

"My adventure with a porpoise occurred six years ago, but the facts are still vivid in my memory and can be accepted as true and accurate.

"We had at the time a narrow beach, reached by a flight of slippery and a bit rickety steps. When I went out to my cabana, no one was in sight, nor did anyone appear when I went swimming, although my husband had asked the owner to keep his eye on me while he was away.

"The waves were not over two feet

W. H. Hodge photos



▲ STRINGED CATERPILLARS, offered by a Mexican vendor as appetizers to be dipped in salt and eaten with the mescal in the small jar

➤ THE MAGUEY PLANT, in which the caterpillars are found



high, and I waded out just waist deep before I realized that there was a terrific undertow. Just as I started to turn back, the undertow swept my feet from under me and knocked me flat in the water. I swallowed a lot of water and, in spite of repeated tries, could not get my footing. I tried to call, but between the water in my lungs and my real fright, I suppose my voice was not loud enough. I realized that, while only about ten feet from shore, there was no way I could make it, and I kept thinking, as I gradually lost consciousness, please God can't someone push me ashore.

"With that, someone gave me a tremendous shove, and I landed on the beach, face down, too exhausted to turn over. I kept thinking that I must turn over and thank the person who helped me. It was several minutes before I could do so, and when I did, no one was near, but in the water about eighteen feet out a porpoise was leaping around, and a few feet beyond him another large fish was also leaping.

"When I got enough energy to get back up the steps, a man who had been standing on the other side of the fence on the public beach came running over. He asked me how I was and said that he had seen only the last part. It was the second time, he asserted, that he had seen such a thing happen. He said that when he had arrived, I looked like a dead body and that the porpoise shoved me ashore. It was his belief that the porpoise was trying to protect me from the other fish, which he described as a fishtail shark. God certainly was with me."

Here we have the first personal account that has come to our attention of a porpoise behaving as legend has said it should. It is easy to conclude, without reflection, that the air-breathing porpoise was intentionally helping a creature who would drown if deprived of air. But most students of animal behavior will probably explain the rescue as a result of the animal's natural curiosity and playfulness. They will doubt that there was any intention on the part of the porpoise to save the swimmer either from drowning or from the "shark." Porpoises do not ordinarily have any acquaintanceship with human beings, do not know whether they breathe air or water, and cannot be supposed to feel love or sympathy for them. To some, an account like this may seem adequate evidence that they do, but the scientist will say that any simpler explanation that satisfies the facts should be given stronger credence.

It is a mistake to analyze animal behavior in terms of human thoughts and emotions. Even in human evolution the idea of doing a good turn for an unknown neighbor is relatively recent. It would be naïve to assume that the porpoise said to itself, "I would want someone to do this for me" ("Do unto others, . . .") or,

"It seems the only decent thing to do. This shark can probably go without one meal, whereas the person will die if left alone" ("To each according to his needs . . .").

True, there is an indication that a parent porpoise will apparently try to support its ailing young at the surface. The young of some marine mammals cannot swim at birth, and when a baby harp seal, for example, accidentally gets into the water, its mother will swim under it and help it up onto the ice again. Some may argue that the porpoise was merely going through its instinctive routine with a person instead of a baby porpoise. Is it not "a wise parent that knows its own child"? Perhaps, but maybe it is a stupid porpoise that doesn't. The mother seal, again, concerning whom more is known, unerringly picks its own offspring out from among hundreds that all look alike to us.

So, what *was* going on in the porpoise's head when it pushed the swimmer ashore? There is general agreement that the creature is sporty by nature. Under training, perhaps it will even conduct itself as "a good sport"—but scarcely in terms of human standards until it has been taught the rules of the game. Even a cynic might find it hard to remain unmoved by the appearance of a porpoise at the scene of a sinking ship, but let's not be too hard on an interesting and intelligent animal if it does not always attend to all the women and children first.—Ed.

### Sparrows and Wrens

SIRS:

In my garden in the country I have a wren house, which has been inhabited this summer by a pair of house wrens. Late in June I noticed a sparrow sitting on the ledge in front of the small, round opening through which the wrens enter the house. The wrens were obviously enraged, but the sparrow continued to sit there hour after hour. When I drove the sparrow away, the wrens burst into song as if trying to express gratitude at their liberation. Since the door to the house is too small to enable the sparrow to enter, I am at a loss to understand what the sparrow was trying to accomplish. The conduct I have described was repeated day after day for several days. So long as the sparrow occupied the ledge, the wrens could not enter their house. After I drove the sparrow away, the wrens would enter and leave the house freely; but no sooner was my back turned than the sparrow would be back and the contest would continue. Can you tell me whether this type of behavior is common and, if so, what the sparrow is seeking to accomplish?

WAYNE McMILLEN.

Chicago, Ill.

The following explanation is offered

by Dr. John T. Zimmer, of the American Museum's Department of Birds:

The incident reported by Mr. McMillen is good evidence of the obnoxious character of the English sparrow, or as it is called in its homeland, the house sparrow. When it can gain entrance to the nest of a wren or some other bird that it can intimidate or find away from home, it may destroy the nest and even break the eggs or kill the nestlings. It may then take possession of the site for its own nest-building activities. When it is unable to force its way into the opening, it may, as in the present case, take a position where it can perhaps find some opportunity of exercising its destructive qualities. It is something like a cat watching a mouse hole. So long as there is evidence that the rightful owner is in residence, the sparrow may continue its behavior, even though it secures no personal gain from it, at least until it finds a more promising object of attention. Should the wrens give up the struggle and leave, the sparrow's interest would probably cease.

There is little that is admirable about this sparrow, although it has been found to eat Japanese beetles in considerable numbers. That is one mark on the credit page for many on the debit page.

### Perfidious Bumblebee

SIRS:

On a bonny spring day some years ago, I retired to a woody, flat-floored dell in quest of the Dutchman's breeches, flourishing profusely in the rich alluvial soil. But—what a name for flowers so exquisite and daintily perfumed!

I was annoyed to find that most of the ones I had gathered were more or less marred by tiny crescent-shaped incisions near the tips of the straddling "kniskers." It was as if the cuts had been made with a midge's manicure scissors, and they had caused rusty discoloration and shriveling. Many of the unplucked blossoms showed similar blemishes.

In a long acquaintance with the species I had never before observed the phenomenon, and I was at a loss to account for the apparent vandalism. It would most naturally be attributed to some mischievous insect—maybe an ant. But what was the *why* of it—on a wholesale scale suggesting system and purpose?

A buxom bumblebee, her sable jacket resplendent with plushy gold, was bustling busily from flower to flower—obviously a queen whom the genial mid-May sunshine had invited from her winter hibernation.

Presently my casual interest became intent: her technique was strikingly novel! Ignoring the conventional avenue ordained by Nature to insure the cross-pollination vital to the perpetuation of many plants, she embraced each blossom like a long-lost friend, then deftly but

Continued on page 431

# NATURAL HISTORY

*The Magazine of the American Museum of Natural History*

F. TRUBEE DAVISON, President

WAYNE M. FAUNCE, Vice-Director  
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ALBERT E. PARR, Director

VOLUME LVIII—No. 9

NOVEMBER, 1949

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You will find NATURAL HISTORY Magazine indexed in *Readers' Guide to Periodical Literature* in your library



## THE COVER THIS MONTH

This remarkable color photograph, taken by Miss Constance Stuart, the only woman from South Africa to serve as photographic correspondent in the last war, portrays two young women of the Ndebele tribe in South Africa. Many groups of this tribe have adopted the ways of neighboring peoples and have thus lost their cultural identity. But the group represented by these two girls, though only a short distance from the capital city of Pretoria, have preserved to a remarkable degree the Ndebele language and much of the traditional culture. Their dress is distinctive and artistic, with abundant use of beads, bangles, and circlelets of brass. Those who unconsciously encourage the native to conform to the white man's gadget civilization might well think twice before hastening the day when such a rich artistic tradition is thrust into the forgotten limbo of vanished cultures.

Further information about this interesting tribe is contained in an article by the distinguished anthropologist Dr. I. Schapera, on page 408.

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Atherlie K. Gidding, *Editorial Assistant*.

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### THE INSECT WORLD

by J. Henri Fabre  
Edited with an introduction and  
notes by Edwin Way Teale

Dodd, Mead & Company, \$3.50  
333 pp., with pictorial end papers

IT is probably safe to say that no writer on insects has won such sensational recognition as did J. Henri Fabre. It was sensational because it came, after years of relative obscurity, in a tidal wave of fame at the close of his life when he was already 84 years of age. The turning point was the completion of his monumental work—*Souvenirs Entomologiques*—and the homage paid to it by writers of distinction. At last the genius who had shunned the world of men in his devotion to a field of interest that most men pass by unnoticed received acclaim not only in France but throughout the world. The last volume of Fabre's *Souvenirs Entomologiques* was published in 1907. By 1911, a selection from this marvelous quarry of entomological information was published in English, and such was the interest aroused that volume after volume, presenting new assemblages of material from Fabre's great work, were issued over the next decade or more.

Fabre's position in entomology as in literature is one of assured eminence, but it is inevitable that with time the wild enthusiasm of the first years of an author's recognition by the world should lose its initial fervor. This is evidenced in Fabre's case by the fact that several of the chapters in Teale's thoughtfully-prepared and well-balanced anthology have been resurrected from sources "now out of print." It is to be hoped that the anthology, which brings together the most stimulating and delightful of Fabre's field explorations and experiments, will not only be valued for itself but may act as an incentive to wider reading of this author.

Teale has done an admirable task of editing. Not the least of his virtues as an editor is his self-effacement. The text is not weighed down by encumber-

ing chains of comment, but a condensed statement preceding each chapter gives just the right amount of information required for a full appreciation of what follows.

HERBERT F. SCHWARZ.

### THE CONQUEST OF SPACE

Text by Willy Ley  
Paintings by Chesley Bonestell

\$3.95

160 pp., 59 plates, 18 figs.

THE mystery of the night sky has always stimulated man's curiosity. From the time he became acquainted with the nature of the moon and planets, he naturally pondered what it would be like to visit them and how this might be achieved.

Chesley Bonestell and Willy Ley have done a splendid job of highlighting the subject of interplanetary travel in *The Conquest of Space*.

Millions have enjoyed the beautiful and scientifically accurate paintings that Mr. Bonestell has done for *Life*, *Coronet*, and other magazines in recent years. These have included the earth as seen from a transcontinental rocket ship, close-up views of the lunar landscape, Mars and Saturn from their near satellites, and dozens of like subjects both in color and black-and-white. Over 50 of them are reproduced here with appropriate captions. To peruse them is like taking an imaginary journey through the solar system on which we see our corner of space from a new perspective. They are not only fascinating to the layman but will withstand the critical examination of the astronomer for, as mentioned in the introduction, they are executed by "a poetical mathematician with a paint brush."

The text, by Willy Ley, has been carefully prepared to answer the hundreds of questions that perplex the nonscientist when he considers the problem of interplanetary travel. There are four chapters covering the basic problems of rocket travel, a discussion of the dimensions and dynamics of the solar system, and interesting data concerning what is known

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of the physical characteristics of the moon and planets.

Chapter IV, called "Vermin of the Skies" discusses the asteroids. We feel that the title of this chapter is not in good taste, but here Mr. Ley has followed a precedent of long standing. The book contains about a score of figures drawn by Mr. Ley to amplify the text. On the whole, it is a valuable contribution to modern popular astronomy.

ROBERT R. COLES.

## INDIAN HILL BIRDS

----- by Sálím Ali

Illustrations by M. G. Henry  
Oxford University Press, \$8.00  
240 pp., 72 plates

**T**IMES and fashions are changing rapidly in India today, but the popularity of the Indian hills as a refuge from the hot or trying weather below is bound to endure. For the many who, in search of relaxation, are drawn to their birds, the present splendid book is intended.

The author, Mr. Sálím Ali, leading ornithologist of India, is also a lifelong student of its birds in the field. Remembering his early days which were handicapped by the lack of a suitable book, he set out "to meet the wants of the

average visitors to the hills" by writing "a handy book that would tell them by simple word and picture something of the birds they meet . . ." He has succeeded admirably. Comparison of size, appearances in the field, simple keys, and tables of distribution identify the birds. But the book is much more than a guide to identification, for under each bird a great deal of information is also given as to habits, food, calls and song, nesting, and other phases of behavior. This information is very complete and is written in a beautifully concise, non-technical language.

Close to 300 species, Himalayan as well as peninsular, chosen as being the most likely to attract the attention of the visitor to the hills, are covered in the book. Of these, 117 are brilliantly illustrated in 64 superbly printed color plates, and twelve additional species are illustrated by photographs. In some cases both male and female plumages are shown. The color plates, painted especially for this book by Mr. G. M. Henry, are beautifully done and include many species that have never been depicted before.

We are told that the book is primarily intended as a field book. But the information given by Mr. Ali on the birds that he covers is so complete and up-to-date scientifically that the professional ornithologist will often refer to it. Particularly helpful are the notes and tables

on distribution, altitudinal movements, and habitats, as well as the two well-chosen end papers showing the paths of the monsoon, land elevations, and mean annual rainfall.

The bird watcher in India and the student of Indian ornithology will be grateful to Mr. Sálím Ali and Mr. G. M. Henry for their very fine book. The only regret an American reader is bound to have is that he is too far away to slip it into his pocket and set off for the beautiful hills.

CHARLES VAURIE.

## HAWKS ALOFT

The Story of Hawk Mountain

----- By Maurice Brown

Dodd, Mead Company, \$4.00  
222 pp., 11 illu.

**H**ERE is the story of one of the world's most remarkable sanctuaries. It is also a heart-warming record of courage, devotion, and idealism.

For many decades Hawk Mountain, on the Blue Ridge of Eastern Pennsylvania, above Dreherstown, was a death-trap for migrating birds of prey. Eagles, vultures, falcons, and hawks of many species, utilizing the favorable updrafts over this ridge, came within easy shotgun range of the hordes of hunters who waited for them among its rocky crags. For many of the local people, shooting at

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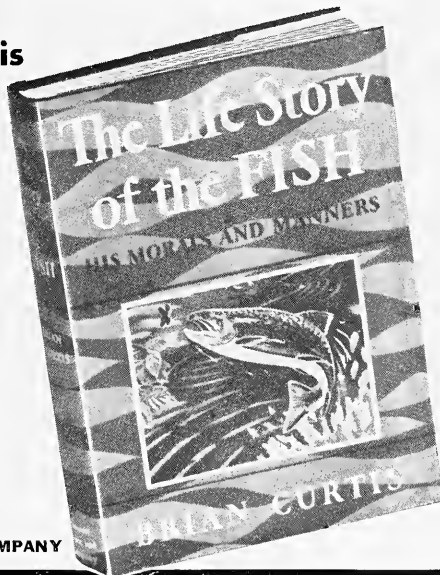
# THE LIFE STORY OF THE FISH

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By Brian Curtis

**"B**RIAN CURTIS has brought a tremendous amount of knowledge together and written it in as simple and engaging a manner as seems possible, all without compromising in the least the scientific principles by which the information was assembled. It is by far the best popular exposition of fishes and their living we have yet seen." — CHRISTOPHER W. COATES of the N. Y. Aquarium, in *Scientific Monthly*.

\*Chicago Tribune



**"I** THINK this must be one of the most all-embracing books about fish that has ever been written . . . whether you are a fisherman or not. But for a real fisherman, this is one of the luckiest books he could come on: he will read it again and again."

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Hawk Mountain was the high point of the year. It mattered little what they shot or whether they killed it or merely knocked it down to lie helpless and suffering for days on the rocks far below.

Then, foreigners from New York invaded the community and leased the property and sought to bar them from their "sport."

It was into such a situation, accompanied by veiled threats of violence, that the Brouns had the courage to step when Mrs. C. N. Edge, of the Emergency Conservation Committee, asked them to become custodians of the area. How they held off the hordes of hunters, won places for themselves in the hearts of a once hostile community, and built the area into a year-round sanctuary supported by thousands of members famous the world over, is the story of this book. In a very informal fashion Mr. Broun tells of his old pre-Revolutionary stone residence on the side of the mountain. He recounts legends about it and its living ghosts—the wild cave rats—with which they share it. He tells of the changing seasons and the birds they bring, of his "Pennsylvania Dutch" neighbors, and the many naturalists from far and wide who have made pilgrimages to Hawk Mountain.

The final chapters dealing in detail with the remarkable hawk flights will be especially interesting to the ornithologist. After explaining the reasons for the

flights and the weather conditions that favor them, the author summarizes his data covering twelve years of flight observation. During that time he has recorded the passing of 179,619 birds of prey, of 16 species. It is possibly a good omen for the future of our much persecuted hawks that 1948 was the best year of all.

We shouldn't assume, however, that one Hawk Mountain sanctuary will solve the problem. Hawks are still slaughtered every fall at many points on the Blue Ridge and elsewhere. Until right-thinking people everywhere rise up in indignation at this wanton and senseless slaughter of some of the finest birds that fly, and display the vision of Mrs. Edge and the courage of the Brouns, our hawks will not be safe.

RICHARD H. POUGH.

## NATURE AND ITS APPLICATIONS

— Compiled by Jessie Croft Ellis

F. W. Faxon Company, 83 Francis St.  
Back Bay, Boston, Mass.  
\$17.00, 861 pp.

THIS imposing index is a most valuable tool for anyone wanting "a picture of . . ." The compiler of such a monumental work deserves the heartfelt thanks of librarians especially, as well

as of the many artists and students needing to know how things look. The index covers many important sources including the *National Geographic Magazine*, two Encyclopedias, and this magazine. Personally, I would rather have included the *Animal Kingdom* or *Illustrated London News* than the *Woman's Home Companion*. And while I appreciate the value of the three pages of references under "Lion" and the four pages under "Palm Tree," etc., I cannot help wondering how much we will use the eighteen pages under "Animal" and the fourteen pages under "Flower."

HAZEL GAY.

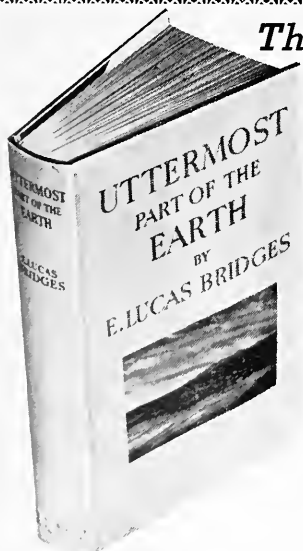
## THE WORLD OF LIFE

A General Biology

— by Wolfgang F. Pauli

Houghton Mifflin Co.,  
653 pp., 524 figs.

IN this very comprehensive work, Dr. Pauli combines the art of story telling with the concise accuracy of the scientist. His subject matter ranges from the vastnesses of interstellar space to the formidable eugenic problems that now confront man. He not only brings out biology in strong relief from its setting in the inorganic cosmos but also covers its every aspect with a fine regard for time relationships and the evolutionary concept. Also, throughout his broad



*The only record which ever could have been written of the little-known savage races of Tierra del Fuego.*

WHEN LUCAS BRIDGES was born on that far-off island in 1874, it was virtually an unknown land. Outside of a few settlements of sheepmen, the 18,000 square miles of mountain, forest, marsh and lake was inhabited by fierce and hostile tribes—the Yaghan and the hostile hunters of the interior—the Ona.

Young Bridges grew up among the Yaghan Indians and knew them well. As a young man he gradually built up a friendship with the Onas and eventually learned their language and became an initiated member of their tribe.

Today only a few hundred of either tribe remain alive, and this account of their customs and lives is a unique record—and fascinating reading.

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treatment of the origin, behavior, structure, growth, and heredity of living things, he particularly stresses the human history of the concepts underlying them in such a way as to make them appear natural and inevitable, rather than miraculous strokes of genius. In thus humanizing the founders of biology, he inspires the conscientious student to go and do likewise.

In his method, Dr. Pauli strikes a happy medium between oversimplification and a plethora of scientific terms. He is convinced that the former has reached a stage where it either distorts the facts or gives the theories a finality they do not deserve. Some burden, he feels, must be placed on the student himself, who can reap his reward only after hard work and hard thinking.

All in all, *The World of Life*, though not directly applicable to the laboratory, is an excellent portal through which to enter any of biology's specialized fields, and it merits a wide sale and use as a general text book. It is profusely illustrated by photographs and drawings, and the artist, Elmer Smith, is to be highly commended for the clarity and instructive value of his sketches.

GEORGE H. CHILDS.

## BEYOND THE CASPIAN

- - - by Douglas Carruthers

Published by Oliver and Boyd  
Tweeddale Court, Edinburgh, 22/6  
290 pp., 25 illus.

*BEYOND the Caspian* gives an intimate insight into a land where few outsiders have penetrated and where still fewer are apt to gain access for many years to come. There may have been changes in the political influences affecting this remote and forbidden land since Douglas Carruthers was there, but the customs of the local people are as ageless as the country itself. Mr. Carruthers has a story to tell—a tale that everyone will enjoy, and he has told it well. He takes the reader to the now almost legendary cities of Samarkand and Bukhara, two of the most intriguing cities that the world has ever known.

Of Samarkand he says, "Samarkand has an atmosphere and character of its own, superior to those of any other Eastern city. It is a beautiful city in beautiful surroundings, a pleasure city as it were, created especially for some super-man, in fact, Timur's throne. Its atmosphere is entirely aesthetic and academic. It exudes—or rather did exude—art, learning and religion. That is its charm."

Here are authentic facts that read like fiction. I can vouch for them because I have been across the same endless deserts and alkali flats, where Mr. Carruthers made friends with the nomads. I, too, climbed up into the rarified air on the roof of the world, where he crossed

through treacherous mountain passes, on the trail of some prized specimens. Don't let the fact that *Beyond the Caspian* was written by an explorer and collector of natural history specimens lead the reader to expect just another travelogue and a big game hunt between its covers. It is a colorful, entertaining, and informative exposition of well-chosen subjects that are delightfully refreshing, and it is told with the simplicity and charm of an accomplished writer.

GEORGE G. GOODWIN.

## GEMSTONES

- - - by G. F. Herbert-Smith

Pitman Publishing Corporation, \$8.50  
537 pp., 44 plates, 145 figs.

THE appearance of the first American printing of this, now standard, work on the stones used in jewelry, marks its return to fill a demand that has long gone unsatisfied. The 9th Edition was printed in 1940 and was a complete revision of a book that had gone through eight editions since 1912. The changes introduced in the American printing are unimportant in comparison with the thoroughness of the revision of the 1940 volume, but they will, nevertheless, add somewhat to the value of the book. The really good news about Dr. G. F. Herbert-Smith's book is that it is again available, after being out of print for the last four or five years.

The first section deals with the physical characters of the minerals used as gems and now includes a long chapter on crystallography, as well as discussion of color, specific gravity, luster, hardness, and the like. An ensuing short section deals with the technology and history of the use of jewelry stones. The principal part of the work discusses the stones that are of chief interest to the jeweler, and following it are shorter sections, now no longer headed "semi-precious" since the phrase is in bad repute, on the less well-known gems. Many of these stones are of interest only to collectors and mineralogists, but it is very gratifying to find them described in some detail in this book. At the same time, this section increases the general interest for nonprofessional readers.

Pearls and organic products that find jewelry application, such as amber, ivory, and tortoise shell, are described in the closing sections. The pages on ivory and plastics are considerably expanded over the 9th Edition. They are appropriate to such a book, which now becomes the only convenient work in which this information will be found. In appendices at the end are numerous tables; specific gravity, compositions, crystal systems, color, refractive indices, and so on, which will be found very useful for reference. A new list of admissible names, as approved in Great Britain is found in this edition.

Will Indian culture survive  
White domination?

## THE INDIANS OF THE SOUTHWEST

A Century of Development Under the  
United States

by EDWARD EVERETT DALE

IS OUR government a land-grabbing monster or a beneficent godfather? Here is a frank, vivid study of how the Indians of the Southwest lived for one hundred years under the United States—their frustrations, their struggles to survive. It reveals in realistic detail the problems of the government, the tenacity of the tribes, their resistance to white settlement and their efforts to retain their own culture.

A "must" for those who want to understand the natives of our land—their past and future. *Illus., bibliography, index, \$4.00.*



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From any standpoint, except the purely romantic interest in jewelry stones to which some recent American books on gems cater, this work is excellent. There is nothing that can be compared with it in English, and the only work in any other language (German) is now out of print. We cannot recommend it too highly for anyone with an interest in gems or in the gemmological aspects of mineralogy. Its many illustrations and four color plates also make it an attractive book for reference, for study, or for reading.

F. H. POUGH.

THE MEANING OF  
EVOLUTION—A Study of the  
History of Life and of its Significance for Man

- By George Gaylord Simpson

Yale University Press, \$3.75  
364 pp., 38 illus.

THIS book, based upon the twenty-fifth series of Terry Lectures delivered at Yale University in 1948, is an interpretation and a critique of the modern concept of evolution. It results from a quarter-century of brilliant research and careful thought by one of our leading students of the subject. Consequently, its publication is an event of great significance to students of organic evolution the world over.

Continued on page 431

# PALMS

## Princes

TO most of us, palm trees and the tropics are synonymous, and why not for this amazing assemblage of nearly 3000 species of plants glories in torrid climates and populates most heavily the wet equatorial regions of the world. Actually tropical America is the real paradise for palms, although tropical Asia is also an important center. Brazil, with her endless square miles of wet Amazon country, probably can boast of more kinds of palms—some 500 species—than any other country, though Colombia, too, has an abundant palm flora. Yet there probably still exist hundreds of unknown species in these two countries alone.

So rich is the heritage of our Western Hemisphere in these wonderful plants that a certain group, the palmettos, even wander as far north as the Carolinas, while another group, the honey palms, reach

as far south as Chile. In between these, another group, the South American wax palms, instead of moving south or north, climb the vertical slopes of the northern Andes not only past the usual upper limits of palms at 4000 feet, not only past the 11,000-foot timber line, but actually to the unbelievable altitude of 15,450 feet, on the Colombian-Ecuadorian frontier. The remarkable thing is that these wax palms are also the world's tallest palms, often attaining a trunk length of 200 feet, a height that begins to approach that of the lofty California redwoods and Australian eucalypti.

Palms are unique among trees, for of the monocots—that great group with parallel-veined leaves, which includes such plants as orchids and grasses, lilies, iris, and cannas—only the family of the palms has evolved the arboreal type

of growth to any substantial degree. Actually palms are not true trees. Except for a superficial resemblance, their trunks are quite unlike those of our common trees, which sport the familiar hard central core of wood which increases in diameter annually and is surrounded by a fairly soft ring of bark. Palms lack a growing layer and scarcely increase the diameter of their trunks, which have a soft spongy heart surrounded by a hard ring of strong

▼ A PALM-GIRT LAGOON has always been a symbol of the idyllic life of the tropics, with food, shelter, and clothing always within reach

*Ernest Gallaway photograph*



They provide almost every basic necessity of life in many parts of the world and are a promising source of new commercial products in world trade

# of the Plant World

By WALTER HENRICKS HODGE

University of Massachusetts

All photographs by the author unless otherwise credited



▲ ITS CRISP, tender terminal buds make the cabbage palm (*Enterpe*) sought after wherever it grows. A view on the slopes of the central Andes of Antioquia, in Colombia

fibers. Often this outer layer is so tough as to repel the blows of all but the keenest ax. For this reason many a settler clearing a tropical forest spares the palms, for they dull his ax too quickly, and after all, they add beauty to a jungle garden plot.

And for the same reason the fibrous trunks of certain tougher-than-ordinary palms find many constructional uses in hot climes. In the Amazonian settler's shack split palm trunks take the place of oak flooring, for they resist termite attack

and are more lasting than any other material. Trunks of the palm called chonta (*Guilielma*) are filled with some of the toughest yet flexible black fibers known. For this reason the species is much in demand and is even semicultivated by lowland Indians of South America for the construction of bows, spears, daggers, blowguns, and blowgun darts. The wood of this abundant and easily grown palm is awaiting an enterprising sporting goods manufacturer who is looking for a flexible yet strong wood for such arti-



▲ A NATIVE GENUS named after the father of our country: *Washingtonia filifera*, often seen growing along California streets

Bureau of Plant Industry photo



▲ FRUIT CLUSTERS of a California date palm, one of the many palms that figure prominently in commerce



◀ CLIMBING the Cuban royal palm for the cabbage bud and for leaves for thatch. Of all the royal palms, the Cuban is the most beautiful

▼ ALL OVER the moist tropics, a palm hut is the favorite native home. This Cuban *bobio* is made entirely from various parts of the Cuban royal palm



◀ WATERPROOF AND WELL VENTILATED: a roof shingled with palm thatch in the lowlands of northeastern Peru. Constructed of materials readily available without cost, such a building will solve the housing problem for a quarter of a century



cles as fine fishing rods and the like.

With but few species growing in temperate latitudes, it is small wonder that palms are strangers to most civilized peoples, who grow up rather with oak trees, pines, or maples. The potted infant palms in our florist shops give little idea of

the majesty of the mature trees, and it is only after a trip to the sunny southland that the winter visitor can really appreciate the palm's stately beauty. And who does not gasp at his first glimpse of savannas peppered with stubby palmettos, of seacoasts girt with wind-combed

coconuts, or busy city streets colonnaded with the slaty shafts of royal palms!

Scarcely a dozen of the several hundred species of palms grown in the warmer parts of the United States are natives, and of these the majority reside in subtropical Florida. Most of the palms that rattle their leaves along the parkways, that enhance our southern homes, or skirt our subtropical sea beaches are immigrant exotics; yet in their native homelands they claim a vast

range of habitats. Depending upon the species, they revel in bright sun or dense shade, in swampland or desert, prairie, seacoast, or mountain.

If Mr. Average Man is unfamiliar with palms in nature, he is just as unfamiliar with their many economic products. To him coconuts

and dates are everyday novelties of the corner fruit store or ingredients of a favorite cake or pudding. But little does he realize that in their countries of origin certain palms constitute the very staff of life of the people. In the realm of economically important plants, palms stand second only to the grain-yielding grasses.

Thus throughout the Pacific isles the coconut (*Cocos nucifera*) is king—indeed, with over 1000 uses, it is one of the world's most important trees. In its island habitat the coconut is always found close to the sea. Conditions there are best for its development, and it flourishes in greatest luxuriance a few feet above high water mark. Under cultivation, it can be found at great distances inland, even at an altitude of 2000 feet, but in such places nut production falls. The results are similar when the species wanders into the subtropics. Hawaii's coconut palms of precivilized times yielded such poor crops that the fruit was a luxury for the privileged males. Woe betide the woman who dared touch it.

Humans have greatly increased the territorial domain of this palm. It has become so closely linked to agriculture that, like many another long-cultivated and protected plant, it has lost whatever aggressiveness it ever possessed and succumbs easily to any choking undergrowth. How real this plant-man partnership has become is reflected in a Cingalese proverb, which avers that "the coconut will not grow out of the sound of the sea or the human voice; nor will it thrive unless you walk and talk amongst the trees."

For such care, the coconut gives bountifully. The ripe meat and its many uses are too well known to list, yet in the Pacific isles the fruit is not used so much by people as by livestock. All domestic animals get their coconut meat rations. Guam natives use this natural food to fatten up a delicacy, the abundant land crab. If fresh coconut meats serve only the livestock, the milk serves only the people and is, on many a tropic isle, the only beverage of the natives.

The coconut can boast the original sealed milk bottle, for what container could have been more convenient or durable on a long sea trip than nature's own tough coconut bottle? Pacific islanders have for years kept their boats stocked with this sealed water supply for emergencies. And perhaps the Spaniards, on their early sailing trips from the Philippines to Mexico, copied this Polynesian habit, thus introducing the coconut to the western shores of the New World.

Bligh's memorable voyage in the "Bounty's" lifeboat might not have been successful without the nourishment provided by the nut. In his journal one can find such descriptive entries as: "May 6, 1789: our allowance for the day was a quarter of a pint of coconut milk, and the meat, which did not exceed two ounces to each person: it was received very contentedly . . . ; May 9, 1789: in the morning a quarter of a pint of coconut milk . . . ; and for dinner, I divided the meat of four coconuts, with the remainder of the rotten bread."

The coconut attains its greatest marketable value as copra. Indeed, in Polynesia this palm product is the only export of commercial value. Nuts to be used in the copra trade are allowed to mature on the tree. When they fall, the meat is pried out and allowed to dry in the sun on mats or platforms. The copra finds its way to the world's manufacturing centers to be converted into a large series of fatty products. The United States normally uses 20,000,000 pounds annually.

Natural oil, to the tune of 50 per cent of volume, has elevated copra to a station where the crop can practically never be overproduced. Butter-starved postwar Europe craves copra by-products for conversion into butter substitutes, while America uses them for soaps and oleomargarines.

Use of soap and oil obtained from copra originated in the Pacific islands, where for centuries the natives have anointed their bodies and hair with Macassar oil. Mixed with sandalwood, the same oil imparts fragrance to the hair of island beau-



▲ THE AUTHOR'S WIFE holds up a newly described species of *yanga* (*Geonoma*), a small palm from the mountain rain forests of Dominica. Its leaves were used for thatch by the Island Carib Indians—the "cannibals" of Columbus' voyages. The pea-sized fruits are seen at right



▲ PALM FLOWERS and fruits push out of curious boat-shaped spathes (left foreground), which are usually hidden at the base of the giant leaves





L. H. Bailey photo

◀ A FINE COCONUT PALM at  
Trinidad, British West Indies

▼ It is in certain parts of the South Pacific that the coconut palm reigns supreme. Here is a shipment of coconuts from Tuamotu. The United States alone imports 20 million pounds of dried coconut meat yearly

AMNH photo

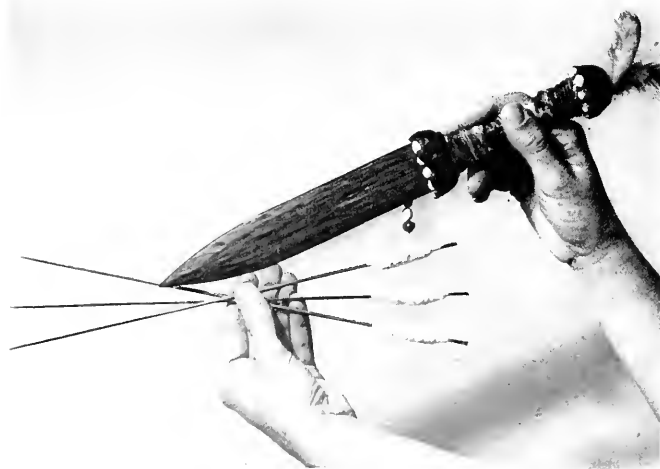


ties—apparently the fragrance that inspired one writer to remark: "Among the islands of the Pacific the smell of rancid coconut oil always brings to mind visions of brown-skinned natives and thatched roofed huts nestling beneath groves of coconut palms."

Milk, copra, and the tough, elastic fibers known as coir all come solely from the coconut fruit. If any

other plant offered this variety of economic usables, we would call it important; but the coconut palm doesn't stop with these mere fruit derivatives. It offers as further proof of its usefulness additional products made from every conceivable portion of its vegetable body.

The single terminal bud makes an excellent salad. The beverage toddy is fermented by the Pacific natives from sap tapped from young flower spathes. Leaves, besides being the chief roofing thatch, are also woven into hats, baskets, and mats,



▲ THE WOOD of some palms is so hard as to resist all but the keenest ax. These are weapons of chonta: a ceremonial dagger and three blowgun darts tipped with curare and wrapped with kapok floss to fit the blowgun



▲ BUTTONS and various articles of artificial ivory are made from the hard white seeds of the tagua palm (*Phytelphas*), whose fruit clusters are shown here in cross section



or are made into brooms or torches. Imported "porcupine wood" is hard and handsome, excellent for cabinet work and veneers; in its homeland it is part of a coconut trunk.

What a tree is this palm! Picture just one day in the life of a Polynesian: a morning coconut oil massage; rations of coconut mash for the domestic animals; a full-course dinner with coconut milk entree, coconut-fattened crabs in a salad with fresh coconut buds, served on platters fashioned from coconut shell, followed by a dessert of coconut pudding. After dinner comes conversation in the flicker of coconut oil lamps, which illuminate the faces of a household reclining on coconut mats in their shelter fashioned from coconut wood and thatched with coconut leaves. Outside, serenely nodding over all, what should one find? Why, of course, a coconut palm!

Dates are to the Arab equally essential, and on the size of the harvest from the date palm may depend the wealth if not the very existence of many a desert tribe. But each tropical region can boast of its own palm favorite. In northern South America it is the *pejibaye*, or peach palm, with an

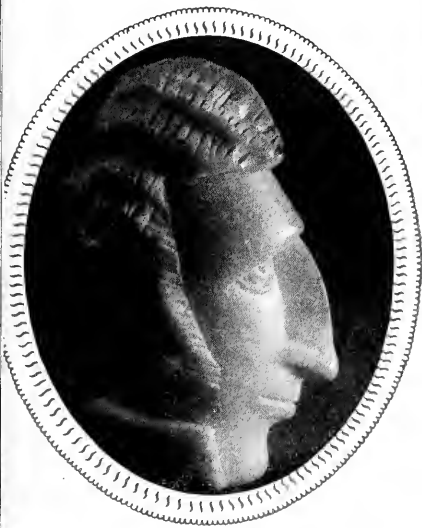


▲ THE SILHOUETTE that spells romance and gentle living: a palm-shaded hut on the Yasawa Islands, Fiji, with the Whitney South Sea Expedition schooner at anchor

edible fatty fruit. In Malaya there is a palm triumvirate, which includes the palmyra with over 800 uses, the starch-producing sago palm, and the much chewed betel-nut palm. In Cuba the superbly beautiful *palma real* (royal palm) is protected by law, for the peasants derive from it a home, the simple native *bohio*, hewn from its timber and thatched with its leaves, while they are occasionally fed by its bud.

Little do we realize the part palms play in each one of our own daily lives. Brazil helps to keep our streets clean by sending us the

coarse bristles from the leaf stalks of the piassaba palm for the brooms of our cities' "white wing" departments. From the island of Madagascar comes raffia, the soft, dried leaf tissue of a palm that is important for its use in basketry. From the strong flexible stems of certain high-climbing palms of faraway Malay is derived rattan, woven into baskets, furniture, or the cane seat of the chair you may be using at this moment. Add the palm oil in Palmolive soap, which comes from the crushed nuts of the west African oil palm; the shredded coconut in your



▲ CARVED from the vegetable ivory of the tagua palm: the likeness of Sucre, liberator and national hero of Ecuador

wife's layer cake; and the fat in oleomargarine with its copra origin. The powdery protective wax that covers the leaves of Brazil's carnauba palm gives strength to your favorite phonograph record and imparts a high protective polish to your waxed floors and automobile. The buttons on your new dress are of vegetable ivory, machine-cut from the tough seed of Ecuador's ivory nut, or *tagua* palm. And the resinous substance called "dragon's blood," obtained from a Sumatran rattan palm, is a constituent of the very finest varnishes. Why, we can't get away from palms!

Although the commercial fibers and waxes obtained from the leaves of various palms are of greatest value to us, the most important single function of palm leaves throughout the whole great range of their growth is as thatch. Palm leaves become the shingles of practically all primitive tropical homes. This is due to their universal availability and general imperviousness to water. On numerous instances, while on a tropical trip of plant exploration, my native guides have whipped up an overnight shelter in five minutes merely by cutting down an ever-present palm and properly arranging the cut-off leaves over a thatching pole. Even in the heaviest tropical downpour, one can be snug and dry under such a crude palm-leaf shelter. More permanent tropical dwellings are more carefully thatched, the roofs being woven together with all the care and technique used in making a finely woven basket. Such native thatching will shed water for years and is cool, in addition. Even the white man accepts this as the best in tropical roofing.

Besides keeping one dry, young palm leaves are an excellent emergency food everywhere in the moist tropics. The edible portion is the palm bud, or so-called "cabbage." Like a cabbage—though a cylindrical one—it is made of tightly packed young leaves that are tender, crisp, and white. The innermost ones are naturally the choicest, having the flavor of cabbage—hence the name. They may be eaten either raw or

cooked. Certain palms, especially the so-called cabbage palms (*Euterpe*), have particularly delicate buds, but almost any palm bud may be eaten. To taste palm cabbage, just fell any palm tree; the plant will be killed, but in a food emergency anything goes.

Despite their long association with man, palms are perhaps less completely known than any other group of flowering plants. This is partly due to the very local occurrence of certain species. Many a tiny island or an isolated mountain valley boasts of a native palm unknown elsewhere. But the chief reason why we do not know them better is that most palms are so tall that botanical study is rendered difficult. To classify new plants, the great botanical museums of the world must acquire pressed specimens of each species for study and permanent reference. Most plants in one way or another can be fitted into an herbarium case on a standard size (11x16-inch) paper mount. But not palms. Think of yourself as an exploring botanist charged with pressing ample material of, say, a talipot palm, whose leaves may be 25 feet long, to say nothing of the gigantic flowering branches. You would probably just forget it, and that is what many a field collector has done. This has resulted in a number of strange situations, and many of these plants, seemingly common enough—often even growing at a botanist's doorstep—have proved to be entirely new to science. For instance, on the tiny British Caribbee isle of Dominica there grows abundantly a cabbage palm locally called *palmiste*, which has been illustrated on local postage stamps for years. Yet no scientist had ever studied this palm until 1940, when it proved to be an entirely new species!

Facts like this have stimulated the interest of at least some professional botanists, who are determined to give palms the careful study they truly merit. The most celebrated student and collector of palms of our times is a nonagenarian, the very distinguished dean of American horticulture—Professor

Liberty Hyde Bailey, who after completing a full and active life at Cornell University decided to study palms. At an age when most individuals are sitting at home, basking quietly in retirement, Professor Bailey may be found doing what is even tough for a young man—climbing tropical mountainsides or penetrating the Amazonian jungles in the search of palms, old or new! Since his "retirement" he has built up at Ithaca one of the largest and best herbarium collections of palm specimens to be found in the world. Dr. Bailey's distinguished studies on this group have been honored by a monument of living palms growing in the famed subtropical Florida garden of an equally distinguished botanical explorer, Dr. David Fairchild, who has also been a devoted student of the palms.

Despite the trouble they give the collector, not all palms are giants. Certain palmettos of the Florida pinelands and of the West Indies are dwarfs scarcely three feet high, with no trunk at all. And not all palms are trees, for Malayan rattans are scrambling vines that clamber upon forest trees often to a height of 200 or 300 feet. But the majority of palms assume the conventional aspect, with straight unbranched trunks topped by feather dusters of large clustered leaves.

Actually the leaves of palms are regularly shed below as new young ones appear at the top, where they are formed by the all-important single terminal bud that is buried deep in the feathery-green crown. Along the many streets where palms have been planted, pedestrians will do well to keep an alert eye for old falling leaves, for a single leaf of, say, a royal palm may easily weigh more than ten pounds—no joke if it lands upon an unsuspecting head. And speaking of royal palms, whose trunks often look like columns of poured cement, a lady visiting a tropical garden for the first time is said to have asked in all earnestness how and why they ever planted those green plants so high on those cement pillars!

Even the novice can distinguish

*Continued on page 429*

# The Lost World of the TAKAHE



In a dramatic rediscovery, New Zealand's flightless, brilliantly-hued Notornis has been rescued from over 50 years of oblivion

By ROBERT CUSHMAN MURPHY

*Lamont Curator of Birds, American Museum of Natural History  
Photographs by GEOFFREY ORBELL and CARL C. SORENSEN*

THE hope of discovering plants, animals, human beings, or handiwork pertaining to a closed epoch has always exercised a peculiar fascination. It is the theme of Conan Doyle's *Lost World* and of Hudson's *Green Mansions*. It is the quasi-reality behind credence in sea serpents, the reconstruction of imaginary continents such as Moo and Atlantis, and the currently reported search on Mt. Ararat for timbers of the Ark!

Recently, two actual finds of this category have stirred popular imagination the world over. The first was the capture off the South African coast of a fish, *Latimeria*, related only to lobe-finned relatives that have been extinct for scores of millions of years. The second was the rediscovery of a bird, the takahe (*Notornis*), which had lived into modern times but of which only four specimens were known. The last of these was collected in 1898. It is noteworthy that *Latimeria* was recovered from remote depths of the sea and *Notornis* from New

Zealand, its only known home and the most remote and isolated of our earth's temperate land masses.

The takahe was first recognized and described in 1848 from skulls and other bony fragments found in postglacial deposits of North Island. The Maori aborigines knew the bird when Europeans arrived, but not until 1851 did an example in flesh and feathers come into scientific hands and the post-mortem security of the British Museum. The subsequent history of the species was sketchy because the bird was rarely seen, and only three more were taken and preserved during half a century. Two of these went to Europe and one remained in a New Zealand institution, the Otago Museum of Dunedin, where it is still exhibited. Few if any of the world's naturalists, with the fate of the moas in mind, believed that a takahe would ever again cross life's stage.

What Is It?

The takahe is a large rail or gal-

linule, flightless though not wingless, brilliantly blue, indigo, and green in the hue of its silky plumage, and equally gaudy in the reds of its large bill and big-footed legs. It is a bulky relative of another and still common New Zealand bird, the strong-flying pukeko or swamp hen, which every traveler sees as he passes through the countryside.

Among land birds, rails have shown an exceptional ability to populate distant oceanic islands, even very tiny ones. From tropical Pacific areas the pukeko reached New Zealand under its own power and within modern times. We can be certain of the latter assumption because, although it far antedated the coming of white men, its traces have never been found among the abounding subfossil skeletal relics of New Zealand swamps and limestone fissures. If it were a truly ancient bird in the country, the evidence could not have been concealed.

Perhaps we should think of the



◀ MR. NEIL McCROS-  
TRE and Dr. G. B. Orbell  
with two of the living  
birds



▼ THE TWO BIRDS on the lake shore.  
Their homeland is one of the most  
inaccessible sections of New Zealand



takahe as the scion of a very much earlier pioneer, that is, a flying immigrant belonging to the same general stock as the pukeko. Later, in the complete absence of predaceous mammals and reptiles—the outstanding ecological characteristic of primitive New Zealand—it could afford to grow big and flightless.

Until the coming of European settlers with their devastating satellites such as pigs, dogs, cats, and rats, and the predatory wild animals like stoats and weasels, which they also introduced from Britain, the takahe found plenty of safe retreats among high mountain valleys surrounded by dense forests of antarctic beech.

#### The Rediscovery

New Zealand is a land of enthusiastic and competent amateur naturalists. One of them, Dr. G. B. Orbell, a physician of Invercargill, cherished at least a half belief in the continued existence of the takahe in the fastness of all but inaccessible wooded ranges of the South Island Alps. He had long collected every available account and rumor, old and new, and in the

New Zealand autumn (April) of 1948 he set forth with a group of companions from the western shore of Lake Te Anau into the pathless forest.

The nature of the New Zealand wilderness deserves a word of explanation. In the southern half of South Island the moisture borne by westerly winds from the Tasman Sea is precipitated by the mountains to such an extent that certain areas receive annual rainfall of 200 inches or even more. This, combined with the ameliorating influence of the ocean around an island considerably smaller than Britain, produces an unexpectedly mild climate. The result is that New Zealand forest, or "bush," as the residents call it, bears a strong resemblance to tropical rain forest, even in a latitude corresponding with that of Montreal. Great trees stand close together, and the shrubs, ferns, mosses, lichens, liverworts, lianas, orchids and other epiphytic growth not only give a strange and elfin aspect to the woods but also make progress in trackless areas extremely slow and difficult.

At Lake Te Anau, which extends north and south for 35 miles in a

drowned valley, the contrast between the primitive wilderness and the country that has been conquered and utilized by man is very marked. To the east, the forest has been largely felled, and there are now extensive areas of grassland devoted to sheep and cattle range and in part to agriculture. To the west, on the other hand, the territory is still virgin and uninhabited, and arms of the lake penetrate the adjoining poorly explored Fiordland of the west coast.

It was into this terrain that Dr. Orbell struck, working his way



Copyrighted photo by V. C. Brozenc

▲ AN AERIAL VIEW of the two wild valleys where the takahe has been rediscovered. The explorers went up the gorge from Lake Te Anau, at bottom

through the forest to an altitude of nearly 2700 feet, until he found a hidden valley and lake, unrecorded on any map but agreeing with descriptions he had received from old Maoris and frontiersmen. On this first visit the party heard only an unfamiliar bird voice and obtained an impression of a footprint in the mud, which was subsequent-

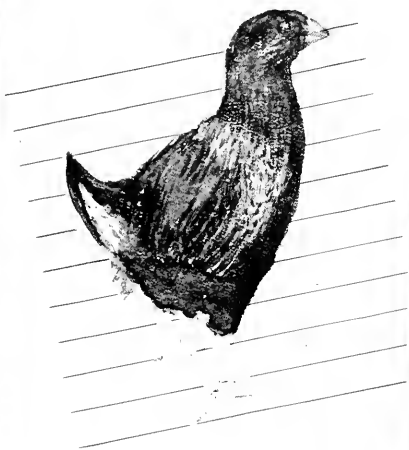
ly identified as that of *Notornis*.

Armed with such encouragement to his growing conviction, Dr. Orbell and three companions returned to the same region in the following spring (November), carrying cameras and 50 yards of fish net. On this occasion his enthusiasm was rewarded by sensational success. He obtained numerous

photographs, including those that illustrate this article, together with a reel of 8-mm. color film that we subsequently had the pleasure of viewing during the sessions of the Seventh Pacific Science Congress in February of this year. He also captured two adult birds, by surrounding them with the net, for close examination and measurement. Both, of course, were later released and, as Dr. Robert A. Falla, Director of the Dominion Museum at Wellington, has written: "It is significant of a healthy advance in public as well as scientific sentiment that no one has demanded a specimen to prove" the rediscovery of *Notornis*.

#### The Takahe's Way of Life

Some time after the cabling of the news to the outside world, where it was received with extraordinary interest, as evidenced by the amount of publicity in the press, Dr. Falla was commissioned by the New Zealand Government to join Dr. Orbell and other members of the original party in a third investigation of the takahe and its environment. This trip was made last January and involved the setting up of a camp in the valley. Dr. Falla has been so kind as to put a copy of his unpublished notes in



► DR. ROBERT A. FALLA, sketching the bird while Dr. Orbell holds it. Adjacent is one of his field drawings



the hands of the present writer. To these we are indebted for most of the information in the following paragraphs.

The homeland of the takahe is in glacial valleys clothed with coarse grasses and wiry scrub that offer little abundance or variety of food to bird life. The same is true of the surrounding beech forest, where the floor is thick with moss. The streams and lakes, dammed up by morainal material in these valleys, likewise appear to harbor singularly little plant and animal life. Keas, or mountain parrots, on the neighboring ridges, a few pipits, the kiwi, and several species of New Zealand ducks are almost the only native fellow residents of the takahe, which is apparently the dominant species of the association.

The takahe proves to be exclusively a vegetable feeder, thus sharing the browsing and grazing habits of the many extinct species of moa. It was observed to strip the flowers

and seeds of snow grass (*Danthonia*) by running its powerful bill along the stalks from base to tip. Bundles of sedges were pressed to the ground with one foot and uprooted with grubbing strokes of the beak, after which the succulent bases were bitten off. Even the fleshy stalks of a spiny and forbidding New Zealand plant known as the Bloody Spaniard (*Aciphylla*) were devoured after the sharp and thorny leaflets had been picked off one by one. Dr. Falla infers that a diet thus restricted would require the consumption of such large quantities of plant food that a *Notornis* population might have a strongly modifying effect upon the vegetation of any limited area. He adds in his notes that if the "moas had similar habits, and there is good evidence that they had, the native vegetation formerly must have been subjected to browsing and grazing pressure of considerable magnitude."

The ground-built nests, the eggs, and the black, downy chicks of the takahe were all discovered during this January, or midsummer, visit. About 30 nests of the season were examined, but it is not known that they were all occupied because it is a habit of gallinules to construct several nest platforms. It appeared probable from observation that most breeding pairs of the takahe succeed in rearing only a single chick, but it is uncertain whether this is due to the birds' inability to save more than one from predatory enemies or whether it is a natural response to the rigors of the habitat and the paucity of food in relation to hearty vegetarian appetites. The total population of takahes in the neighborhood of the camp was not accurately determined, but it is believed that two adjacent valleys may have supported colonies totaling between 50 and 100. Twelve or fourteen different adult birds were actually seen by members of the party.

Not until this summer (the New Zealand winter) was it learned how the hardy takahe fares during the season when the South Island Alps are snowbound. A party that included Mr. E. G. Turbott, a leading ornithologist of the country, broke its way into the high valley on August 22, finding signs of seven takahes and sighting two.

It appeared that in winter the birds wander rather widely over the snow, seeking shelter and food in the fringes of the beech forest, to which they may be largely confined throughout the periods of northwesterly weather that bring the heaviest falls. Each such cycle is preceded, however, by a strong thaw, and at such times the birds promptly return to the open country to feed upon the re-exposed snow grass.

#### The Future

Official New Zealand responded with dramatic thoroughness to the takahe's need of the most rigid possible protection. Here, it seemed, was an opportunity to atone in part for the ignorance or lack of foresight that had led to the loss of so large a proportion of the native fauna and flora.

Within a month after the discovery, the Government proclaimed a closed sanctuary of 400,000 acres to afford inviolability to the mere 500 acres, more or less, in which the living birds were found. Regarding the next steps in the program, Dr. Falla has written:

"As far as the Te Anau colony is concerned, it is imperative to ease the predator pressure or prevent it from increasing; and a plan for this already is being operated by officers of the Department of Internal Affairs. The possible existence of other colonies also is being investigated; and with the present active revival of exploration in Fiordland, and the fact that takahe country and unmistakable traces of the birds can now be recognized easily, results may be expected."

Perhaps the long-delayed rescue of the bird from oblivion may prove to be the blessing that will enable us to keep it forever.



◀ THE FIRST WHITE WOMAN to hold a *Notornis*: Miss Joan Telfer taking the bird from the net



OLNEY, Illinois, 250 miles south of Chicago, is popularly known as "The Home of the White Squirrel." And the claim is no idle boast, because nearly 1500 perfectly white squirrels are estimated to live there. They can be found at any residential point in the city, being perhaps more numerous near the city park in the lightly populated northern edge of Olney.

The first white squirrel was discovered about 1902 near Sumner, Illinois, 20 miles east of Olney. Mr. George W. Ridgely saw one in the woods near his home south of Sumner. It disappeared for a short time but reappeared with a cream-colored mate. Mr. Ridgely wanted to trap them and tried to enlist the aid of a neighbor, who, since he had not seen one of the white animals, promptly remarked that Mr. Ridgely was either drunk or crazy. However, after several fruitless attempts the squirrels were captured in a trap rigged in a limb den. Mr. Ridgely kept them for a while and then sold them to a saloon owner, Mr. Jap Banks. Banks exhibited them in his window until a state act made it illegal to keep wild animals in captivity for display purposes.

The squirrels were given to two boys and permitted to run loose. The male was killed, but the female raised a litter. From then on, the animals bred and thrived steadily. They will interbreed with gray squirrels but not with the larger fox or red squirrel. Progeny of a white and a gray squirrel is usually gray or white or any shade between.

At various times, pairs of the animals have been taken to other sections of the country, but so far as is known they have never multiplied elsewhere. Battle Creek, Michigan, is noted for black squirrels, but a deal whereby the two cities would exchange their specialties recently fell through.

We are assured that these white squirrels are the albinistic form of our common gray squirrel. The fact that they will interbreed freely with the gray squirrel while not mixing with the fox squirrel helps prove this point, according to Mr. T. Donald Carter, of the American

# White Squirrel Town

By HARRY READ



▲ ONE OF OLNEY'S many distinguished citizens Null's Studio photo

Museum's Department of Mammals. The photograph, he adds, also shows this to be the case.

"Albinistic or white gray squirrels occasionally appear anywhere within the range of the gray squirrel," states Mr. Carter, "and at times a colony of albinistic animals becomes established, as has occurred at Olney. Ernest Thompson Seton, in his *Lives of Game Animals*, mentions such a colony at Greenwood, South Carolina. He states that in 1916 there were about 100 white squirrels in this colony and that they had been observed there for about 22 years. Another colony, which I personally visited, was at Bloomfield, New York, not far from Canandaigua. I do not know if this

colony is still in existence. At the time of my visit, about twelve years ago, there were a number of white gray squirrels about the town.

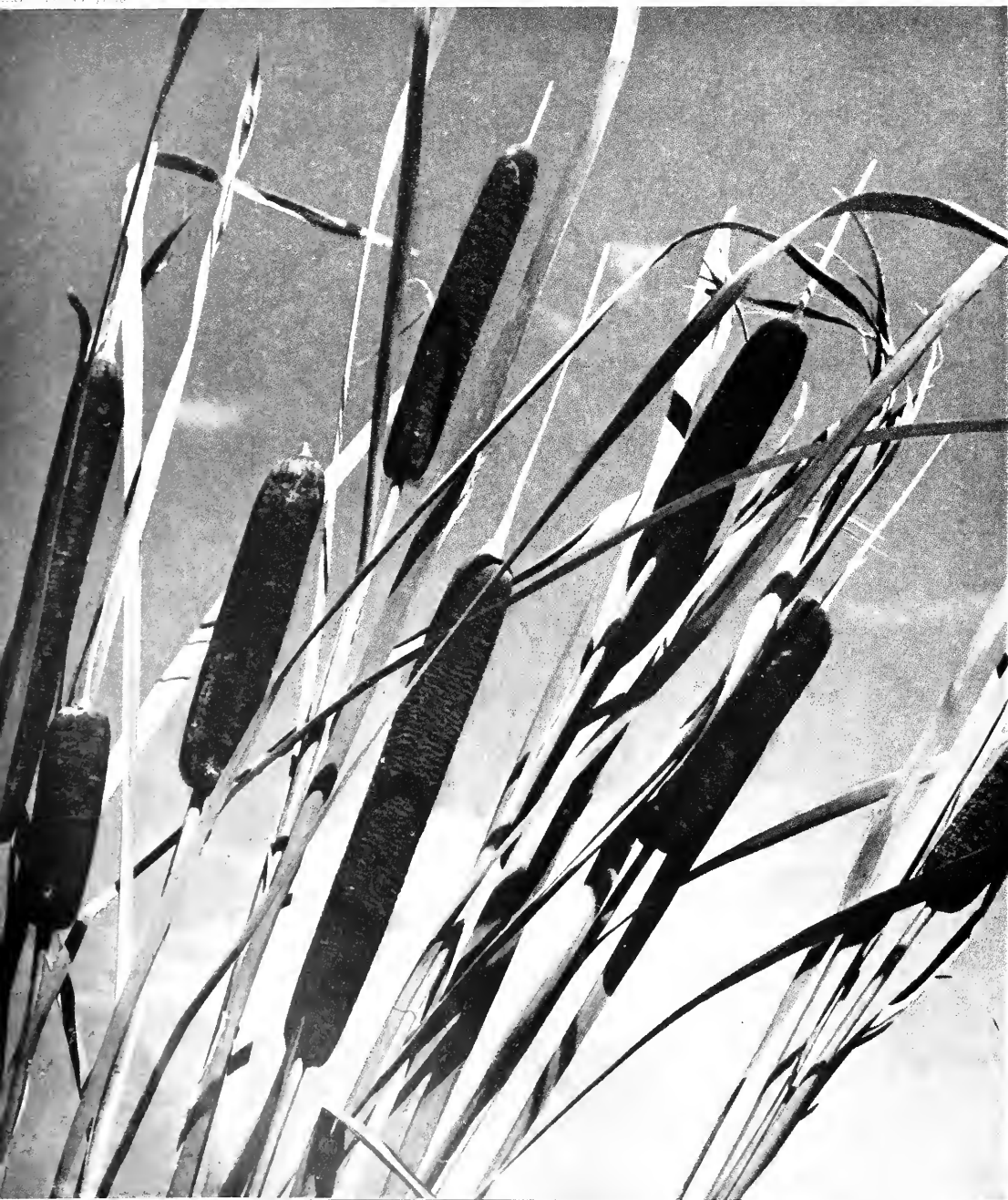
"The black squirrel, which is common in certain sections of the northern states and Ontario, is the melanistic form of the gray—the opposite of an albino. In certain sections, this black form is more commonly seen than the normal gray. In northern Bronx in New York City, the black are not rare and in a few places are as common as the gray."

In Olney, Illinois, the pure white squirrels have become domesticated to the extent of frolicking on lawns and eating from the hand, and they are protected both by an Illinois law and a city ordinance.

# The Strength of the *Cattail*

▼ **THOUGH** outwardly familiar to all, the cattail offers a surprising illustration of strength with lightness to anyone who dissects it with a razor blade

*David G. Smith photo*



Ages before man's development of engineering science, Nature produced the "patent model" for an airplane wing

By EDWIN WAY TEALE

Photographs by the author except where otherwise credited

WHEN gusts sweep across a cattail marsh on a windy day, the slender green leaves twist, flutter, bend, and gyrate. But they rarely break. And when the wind dies down, they return to their former position. Although such leaves may rise 100 times their width and more than 500 times their maximum thickness, although they are feather-light and partially filled with air, they are able to withstand

innumerable stresses and tensions. The cattail leaf represents a marvel of Nature's engineering.

The secret of its strength lies in its internal construction. Cut across a cattail leaf with a razor blade—either a broad-leaved cattail, *Typha latifolia*, or a narrow-leaved cattail, *Typha angustifolia*—and what do you find? You discover a remarkable system of internal bracing comparable to that of an airplane wing.

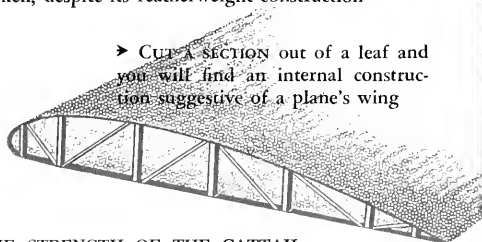
Millions of years before the Wright brothers flew at Kitty Hawk, Nature devised the maximum lightness and strength construction of modern aircraft design.

In the series of photographs on these pages, you find some of the similarities between leaf and wing. Not only does the cross section of the leaf show a construction almost exactly like that of the ribs of the earliest airplanes, but the camber and thickness of both wing and leaf decrease from base to tip. Six cross sections, taken at different points along a latifolia leaf five-eighths of an inch wide and seventy-two inches long, are shown in one of the photographs. The series, showing the internal construction of the leaf at various distances from the base, reveals how the leaf, like



▲ THE LEAF can be bent like a bow without being broken, despite its featherweight construction

➤ CUT A SECTION out of a leaf and you will find an internal construction suggestive of a plane's wing



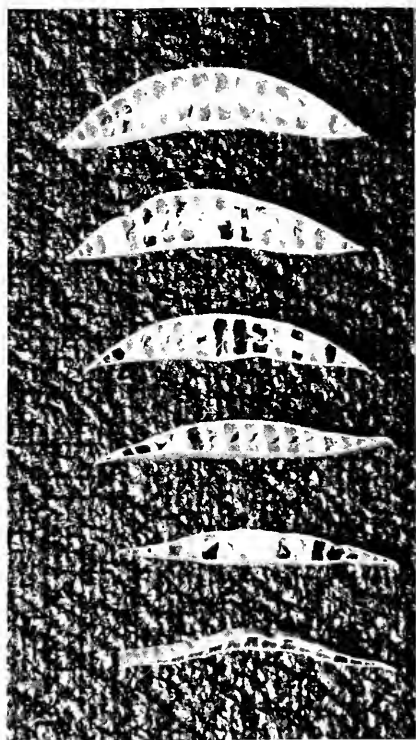
the conventional airplane wing, grows thinner and less convex as it approaches the tip.

Running the full length of a cattail leaf, from base to tip, are veins that are comparable to the longitudinal spars of the aircraft wing.

Inside the leaf, if a section of the top is removed with a razor blade, you discover innumerable cells, their walls forming a mesh or open network. These cells can be examined from the side by splitting the leaf vertically and folding back the



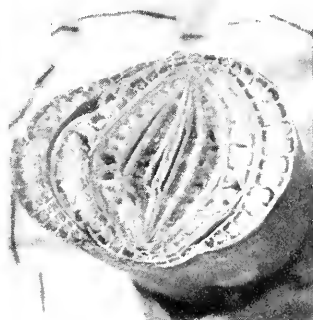
▲ SO STRONG are the leaves that in a high wind they will only lean and then return to their normal position. Sometimes the roots will be upturned before the leaves break. (*Typha angustifolia*)



▲ SECTIONS at intervals of about a foot show that the leaf becomes less curved and thinner toward the end, just as an airplane wing does

two halves. This framework of open cells, in staggered rows, is an important feature in providing the leaf with the greatest strength for the least weight.

For nearly 20,000,000 years, the cattail leaf has been making use of this construction. Curiously enough, although this water plant has been on earth so long, it forms one of the smallest families of flowering plants, having but a single genus. Two species are the familiar, wide-spread *Typha latifolia* and the narrow-leaved *Typha angustifolia*. The latter is confined to calcareous regions inland and brackish waters near the coast. At one time, the leaves of this cattail were harvested for making paper and for sealing watertight casks. The dried leaves were inserted between the staves.



▲ A CROSS SECTION through the bundle of leaves near the base shows how the cell construction develops

◀ SLICING OFF the surface of the leaf reveals a system of hollow cells separated by lengthwise and crosswise braces. This picture is of *Typha latifolia*

▼ THE SAME LEAF, when split lengthwise and folded back on itself, shows the crosswise divisions that reinforce the longitudinal ones

Later, when the container was filled with fluid, the leaves swelled to form a perfect sealing at the seams. It is the air-borne seeds that spread the cattail over wide areas. Once established, however, the perennial roots continue to advance, so that a stand of cattails an acre in extent often represents only a few plants.

Paradoxically, the strength of the cattail leaf occasionally proves a disadvantage to the plant. Cattails are pioneer land builders. Their interlacing roots push out into deeper water along the edges of shallow ponds. Advance clumps, insecurely anchored, sometimes meet disaster when they are capsize by the wind. The internal bracing of the lightweight leaves is sufficiently strong to withstand the gusts. They bend but do not break, and in this straining tug of war it is the massed roots below rather than the leaves above that give way first.





# The Ndebele of South Africa

A vivid glimpse of one of the least-known native tribes of the Transvaal—a colorful people who have not surrendered their identity to the firm grasp of Western culture

By I. SCHAPERA  
*University of Cape Town*

Photographs by  
CONSTANCE STUART  
*From Black Star*

THE WOMEN delight in bead ornamentation. The white, red, and blue beads are bound firmly around a ring of dry grass

THE people illustrated in these pages live scattered about in the northern and eastern districts of the Transvaal, South Africa. They are divided into a number of separate tribes, each under its own chief, but they bear the collective name Ndebele and claim to have had a common origin. Their traditions relate that they once lived to the southeast, in what is now Natal, whence they migrated to their present homes many centuries ago. This suggests that they are ethnically connected with the Zulu (who still live in Natal), and certainly their language and customs, where still preserved, show that they have many close affinities with that famous warrior people.

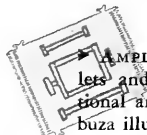
Nevertheless, most of the Transvaal Ndebele have virtually lost their identity. Living for centuries closely surrounded by peoples of

Sotho stock, they gradually acquired the language and even the usages of their neighbors, and today there are in the country several tribes, such as the Seleka and Mafate, whose traditions show that they are Ndebele but who in all other respects—physical, linguistic, and cultural—are indistinguishable from the Sotho.

This fact lends all the more interest to the groups photographed by Miss Stuart. Unlike the others, they have preserved to a remarkable degree their language and much of their traditional culture; and to find, within twenty miles of Pretoria (the Union of South Africa's administrative capital) people who still wear such distinctive costumes as here illustrated shows that the reputation they enjoy of being very conservative is well founded. Contact with white missionaries, farm-

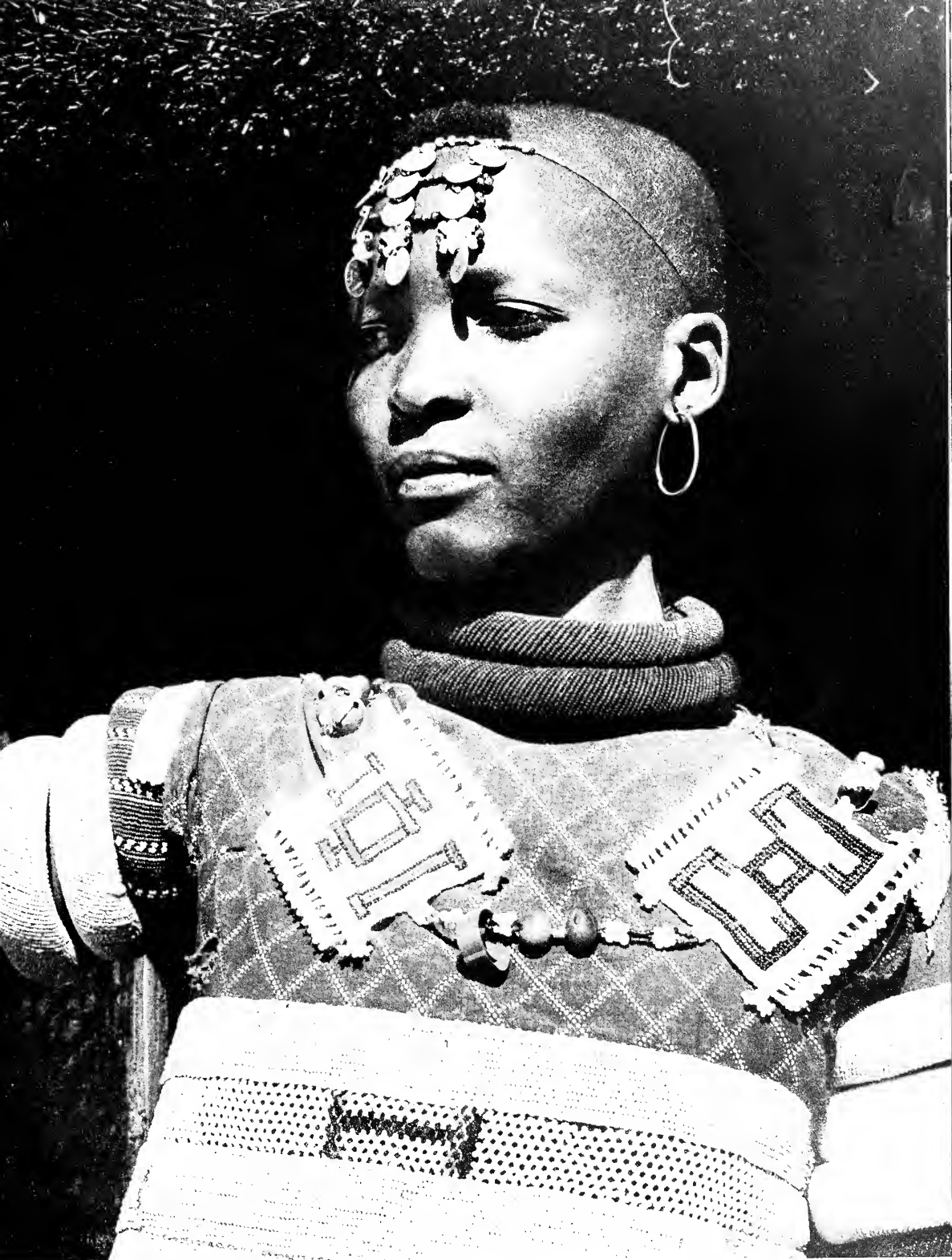
ers, and others has of course made itself felt in various ways. The men, for instance, all wear European clothing and go out in large numbers to work in towns or on the farms. But most of the women have retained the old national dress, consisting of skin petticoats and innumerable bangles and circlets of brass and beadwork, which are very much in evidence on festive occasions; and the customs connected with domestic life and magic also persist fairly strongly.

Like many other South African Bantu, the Ndebele live in small



AMPLE ADORNED with the armlets and bangles that are traditional among her people, Khumbuzi illustrates well the personality of the Ndebele. Her name means "Energetic Person"

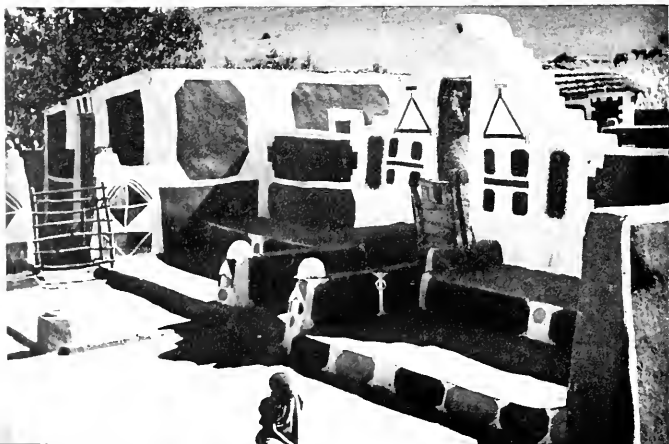






▲ IN FULL CEREMONIAL DRESS. The short bead skirt is a sign that this Ndebele belle is unmarried. Some of the head rings are made on her and are not removable

► THIS GABLED ARCHWAY shows the Ndebele's love of decoration and sense of architectural design. Few other Bantu tribes show these talents



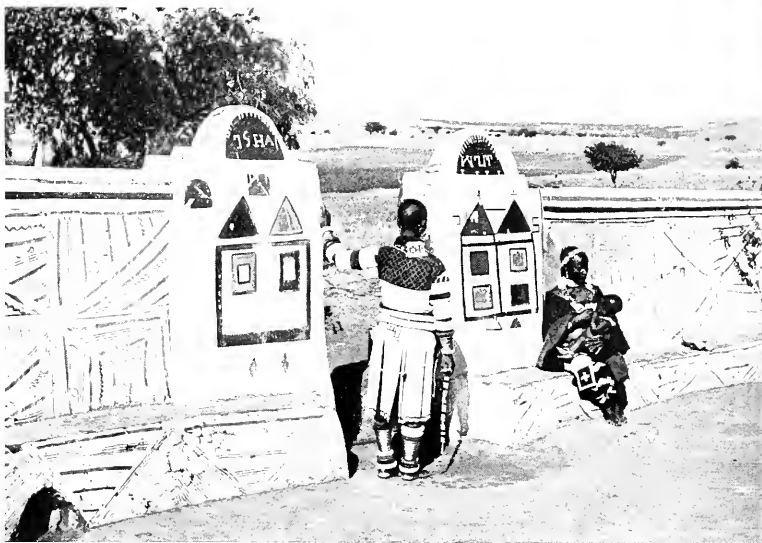
villages, each inhabited predominantly by the members of a single family group, consisting basically of a man and his married sons, with their respective wives and children. Their huts were formerly made of wattle, in beehive shape, but today rectangular dwellings of European type are commonly built, with stone foundations, earthen walls, and thatched roof. The mural decorations, so well illustrated in the photographs, are apparently also a borrowed feature, being characteristic of the Sotho peoples rather than of the Nguni (to which group the Ndebele belong by origin). But whatever the type of dwelling, the traditional ceremony of having it "doctored" by a magician is still faithfully observed. Before the foundations are laid, pegs smeared with medicinal ointment are buried at the corners and in the center of the site. This, it is held, will protect the inhabitants from sorcerers and other evilly disposed persons, whose power to work harm is thus neutralized as soon as they come within the boundaries marked out by the pegs.

The number of huts that a man builds depends upon the number of his wives, each of whom must have her own hut. Polygamy is the ideal, and the more wives a man has, the greater may be the esteem in which he is popularly held. In the choice of a bride, preference is given to one's maternal cross-cousin (mother's brother's daughter). This, too, is a feature borrowed from the Sotho, since all other Nguni peoples prohibit mar-

riage between first cousins of any kind.

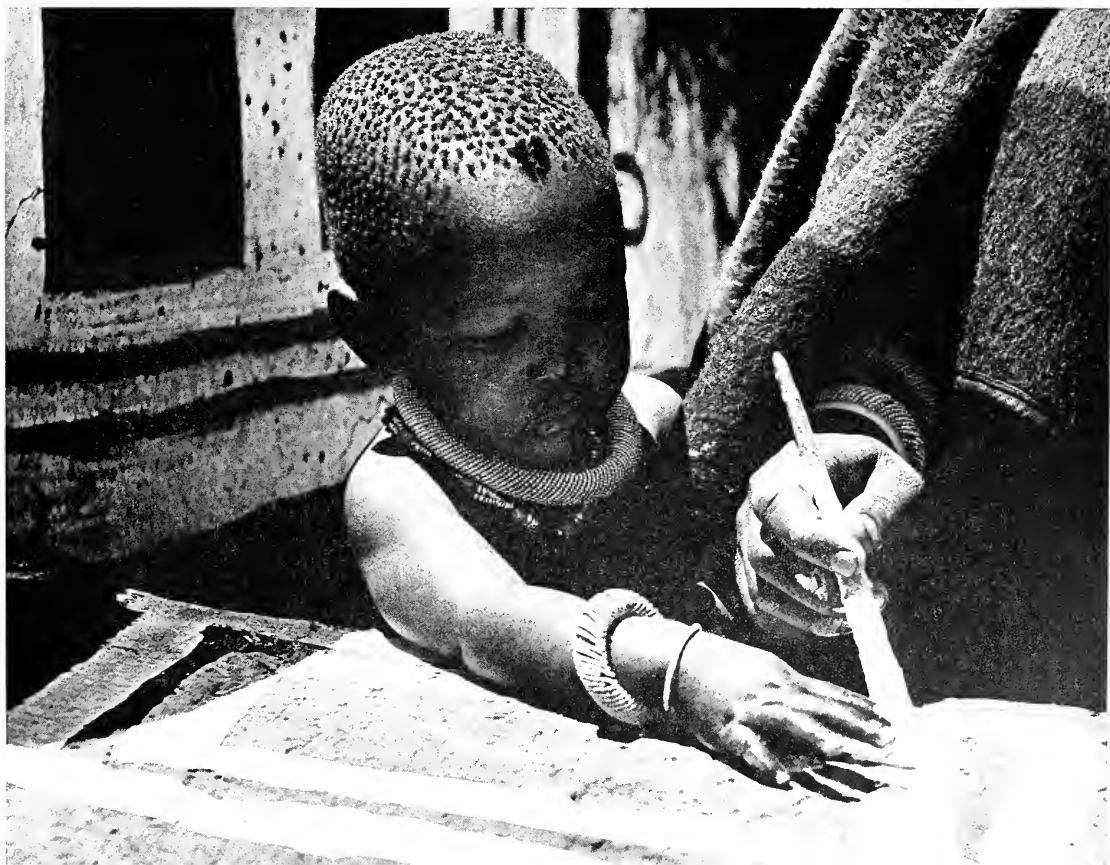
A young man usually chooses his own wife, but once the girl has agreed to marry him, the negotiations leading to formal betrothal must be conducted, according to stereotyped ritual, between their respective parents. To the parents of each wife that he marries, the man must give cattle, the usual number being six head.

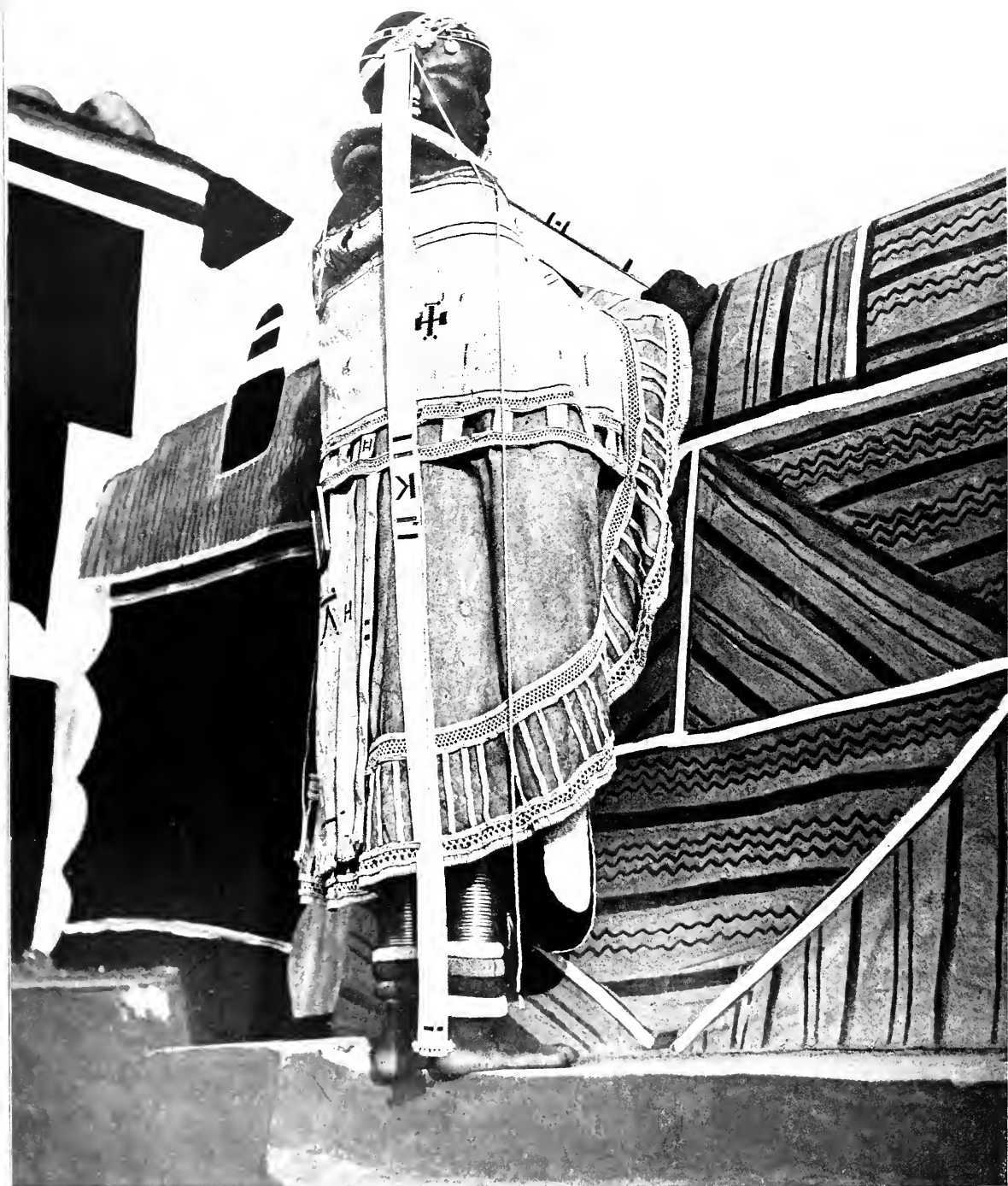
Once married, a woman goes to live with her husband in the village of his father, where a new hut has been built to accommodate her. On the appointed day, she is accompanied from her own home by a sturdy girl friend, specially chosen to help her on this occasion. They sit down on the open veld, some distance from the village. The bridegroom, accompanied by a



▼ THE YOUNGSTERS have a wonderful time when their parents are busy painting

▲ THE DESIGNS on each side of the gate are in paint. The others have been drawn on damp clay with a sharp stick. The latter are fairly common in the central and western Transvaal and even in Bechuanaland. The ones on the gateposts are more unusual and represent a distinctive modern development among these people





▲ THIS MAGNIFICENT CLOAK is worn by the bride on her wedding day but never again. Three months before her marriage, her father kills a sheep and fashions this skin cloak for his daughter. Then her

friends set to work on the embroidery. The long bead strip hanging from her headdress takes the place of a wedding veil. She carries a short wedding stick

band of youths and maidens, goes out to search for her. She and her friend, when found, are expected to offer resistance and must often, it is said, be carried forcibly into the hut. The door is firmly closed, so that they cannot escape. The bridegroom then begins to kindle a fire; the bride and her friend try to prevent this by kicking the fireplace to pieces, while the husband's companions try to restrain them. If he succeeds in lighting the fire, he begins to prepare a meal. This also the bride and her friend hinder as best they can; they slap and kick and do everything possible to prevent the cooking of the meal. When at last she gives up the struggle, she drinks a calabash of beer with her husband; and with that the

ceremony of "dragging" her to his home is completed.

The young wife does not start her own housekeeping until after the birth of her first child; till then she works under the direction of her mother-in-law. Every married woman looks forward to bearing children, and if she remains childless, it is held that she either has been bewitched or has violated some important rule of conduct. In such cases, her husband may demand from her parents her younger sister or her brother's daughter as a substitute to "wipe away" the disgrace of her barrenness. So, too, if a young wife dies before having borne a child, her husband is entitled to a substitute, failing which he may claim the return of his cattle. On the other hand, if he himself dies while his wife is still relatively young, she is taken over by his younger brother or by some other close relative, who cohabits with her in order to raise seed to the deceased. All these usages indicate that the Ndebele would readily

agree with the Anglican prayer book in holding that "marriage is ordained for the procreation of children."

Children, almost from the time they are able to walk, help their parents. The boys look after the lambs and kids and, as they grow older, are entrusted with herding, first with the calves and small stock and then with the large cattle. The girls help their mothers fetch water and wood, clean the home, cook the meals, and so forth; and as they approach puberty, they also take part in the cultivation of the fields.

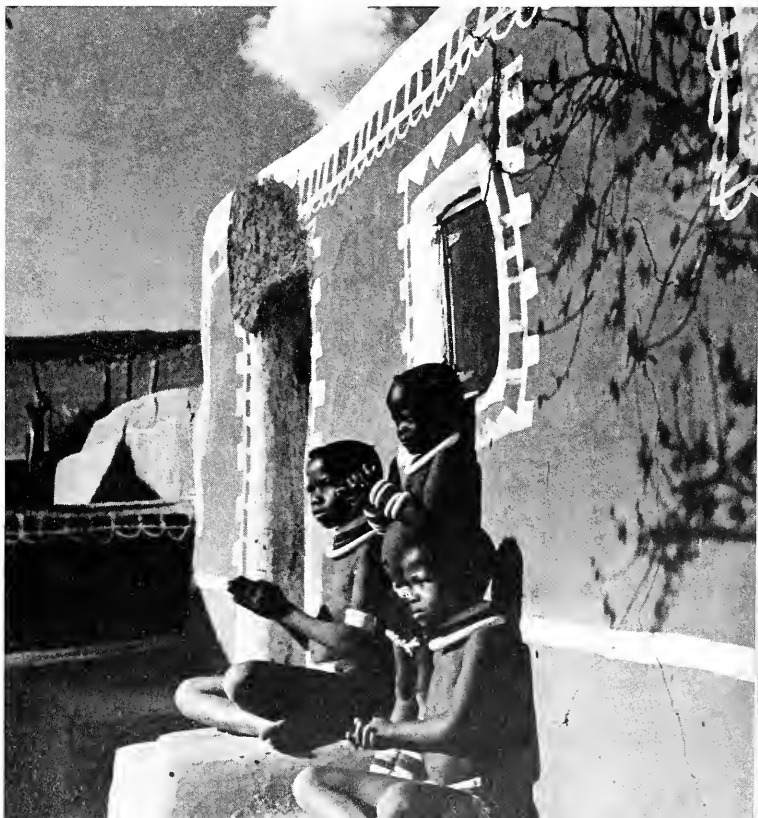
These are only a few of the customs that the Ndebele still observe despite the changes produced by contact with western civilization. Other usages have apparently become obsolete, such as the worship of ancestors, the ceremonial eating of the first fruits (at which the chief took inviolable precedence), the "doctoring" of the tribal army before and after battle, and the traditional system of tribal government. With their decay, much of



▲ MODERN IMPLEMENTS but ancient coloring material. Notice the clay at left, which she used in making her design. Her name is Nzangobe, meaning an unafraid and forward person. Painting time is usually early spring or in honor of some ceremonial affair



➤ THESE CHILDREN are welcoming the spring, clapping their hands and singing







the glamor and color has departed from the life of the Ndebele. The modern farmhand or mine laborer, living under the rule of an alien government and exposed to all sorts of new influences, is a very different person from his ancestors. But the people still have enough of their old culture to form a picturesque section of the South African Bantu; and Dr. N. J. van Warmelo, our main authority, rightly described them in 1930 as "an unworked mine of ethnological information." That mine has by no means been fully explored; and the Transvaal Ndebele still rank among the least known inhabitants of the country.

◀ **SHAVING THE HEAD** is a regular fashion, but the decorative bow is a whim from Woolworth's Bazaar. Note the cheerful, smiling face and magnificent teeth

▼ **ON SUNDAYS** the women of the Ndebele dress in their best and visit each other







## HOGNOSE SNAKE —

▲ THOUGH OFTEN MISTAKEN for a dangerous snake, the hognose is quite harmless

# *Possum Player Extraordinary*

Scientists doubt that when it "plays dead" it is consciously deceiving its enemy

By GEORGE M. BRADT

*All photographs by the author*

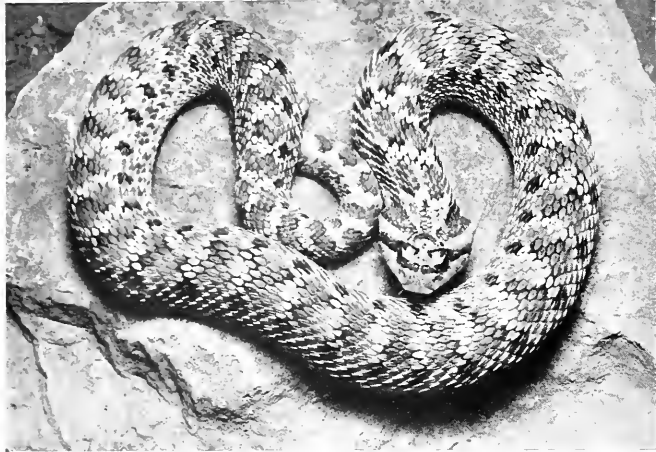
WHEN a hognose snake plays possum, it outdoes even the famed marsupial for which this curious defensive behavior is named; it literally outpossums the opossum. Many animals feign death when their lives are threatened. Foxes, terns and rails, various lizards, spiders, and beetles, even measuring worms, wood lice, and water scorpions are known to resort to this strange stratagem. But none can equal in interest and variety the bizarre death-feigning of the hognose snake.

Most possum players are pacifists

at heart and surrender without a fight when face to face with danger. They just "curl up and die." But not hognose! At the appearance of an enemy, this versatile reptile dilates its head and neck to form an arresting cobra-like "hood," flattens its stubby body to make it appear larger, inflates its single lung with air—then strikes and hisses in a manner guaranteed to startle anyone unfamiliar with its true nature. This formidable behavior has not only earned it a reputation for being aggressive and

highly poisonous, as well as the sinister names "puff adder," "hissing viper," and "spread head," but has assured it a speedy and violent death whenever encountered by man. Actually this common American snake of the genus *Heterodon* is utterly harmless and can seldom be induced to bite. Its act is pure bluff!

If a suspicious adversary calls its bluff, however, hognose proceeds to get out of the game and cash in its chips in a most unusual way. Instead of trying to run away "to live to fight another day," hognose

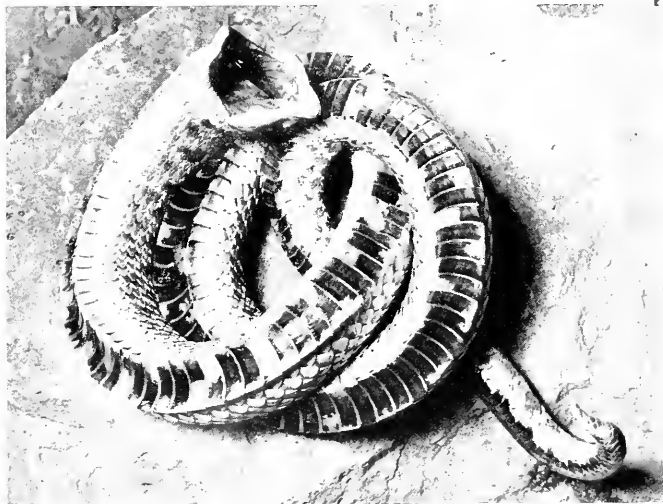
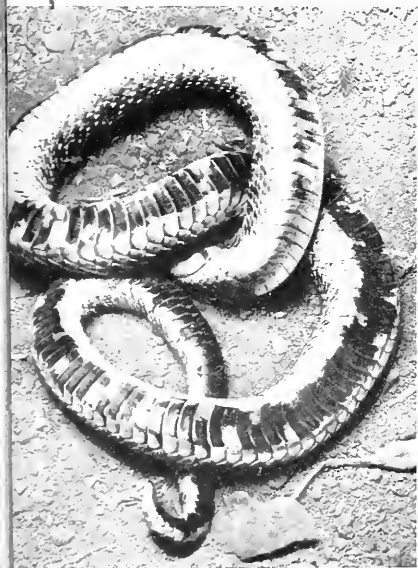


◀ BEFORE SIMULATING helplessness or death, the hog-nosed snake flattens its head and body in this "bluffing" pose



▼ WHEN THIS INDIVIDUAL was first seen sunning itself in the middle of a paved highway, it lunged and hissed in the best hog-nosed manner. After it quieted down, it was placed on a flat rock, where it demonstrated its death-feigning pose nicely for this photograph. In this position, it failed to bite when the author placed his little finger into its wide-open mouth. A few minutes later it righted itself and glided away

▼ AFTER TWO PREVIOUS PERFORMANCES, the snake was gently prodded with a stick to induce it to "die" a third time. It then rolled over onto its back and coily tucked its head beneath its body, as if to say, "Go away, I want to be alone"



simply stops lunging and hissing, rolls over onto its back, gives a few convulsive wriggles, opens its great mouth, and "expires" before its assailant's astonished eyes. A "deader" snake cannot be imagined. So well, in fact, does this histrionic creature enact the role of the deceased that any number of indignities may be perpetrated upon its scaly person. Raymond Ditmars wrote of tying these snakes into knots, hanging them over rail

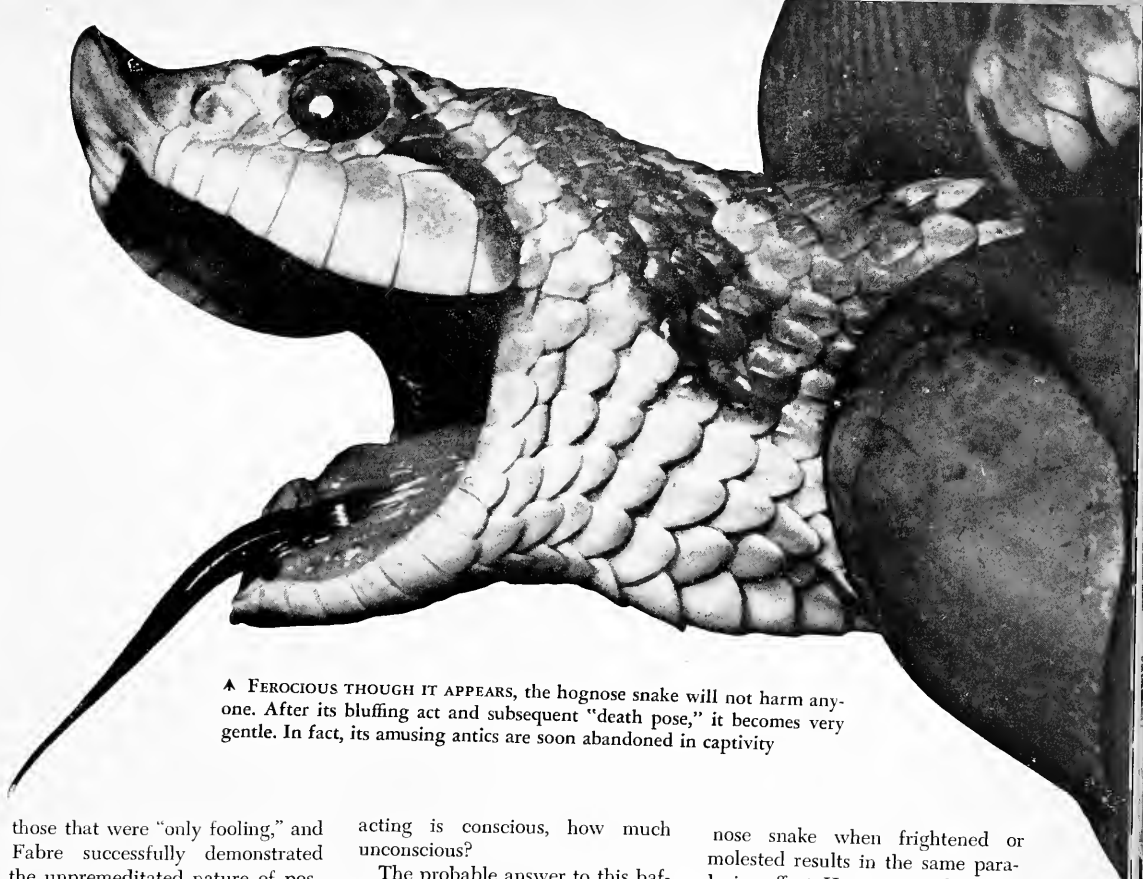
fences, and carrying them about by the tail for long periods of time without their showing the slightest sign of life. A finicky captor, taken in by its victim's sudden "death," is apparently supposed to turn up its nose at such inedible carrion and depart, leaving the "remains" for the vultures. It is doubtless true that many a hog-nosed snake owes its life to the success of this ruse.

Should it be left for dead, however, it makes a miraculous recovery and, after turning over onto its belly, quietly glides away. It waits for no applause, no curtain calls; its act has served its purpose. But let its enemy reappear and hog-nosed eagerly performs an encore, "dying" a second time before its presumably gullible audience. It can be made to repeat this ludicrous performance time after time by

merely placing it on its stomach, from which position it immediately throws itself onto its back to "die" again and again!

After witnessing the realistic death-feigning act of the hog-nosed snake, it is difficult not to credit this amazing creature with great intelligence, cunning, and presence of mind. One is tempted to believe that its convincing bluff and subsequent demise are part of a deliberate plan to deceive its enemies. But, disillusioning as it may be, this is not the case.

Naturalists have for years been intrigued by the so-called death-feigning instinct in animals but have long suspected that there was more involved than met the eye. Darwin was impressed by the differences between the positions assumed by really dead insects and



▲ FEROCIOUS THOUGH IT APPEARS, the hognose snake will not harm anyone. After its bluffing act and subsequent "death pose," it becomes very gentle. In fact, its amusing antics are soon abandoned in captivity

those that were "only fooling," and Fabre successfully demonstrated the unpremeditated nature of possum playing among beetles. Thirty-odd years ago, in his *Studies Of Animal Behavior*, S. J. Holmes discussed the above experiments of Fabre and Darwin and added that in his opinion, "The expression 'feigning death' is a misleading one to the extent that it is apt to give rise to the idea that the animal consciously adopts this device with the intent to deceive." Nevertheless, Professor Holmes did consider it possible that in birds and mammals there was "a tolerably acute consciousness of the situation." W. H. Hudson, in *The Naturalist in La Plata*, has an entire chapter on death-feigning, and himself found it difficult to reconcile the apparent insensibility of the Argentine fox under the cruel beatings inflicted upon it by Hudson's gaucho companions with the fox's cautious and deliberate flight at the departure of its enemies. The question has always been: Does the fox, or opossum, or hognose snake *feign* or just *faint*? How much of their

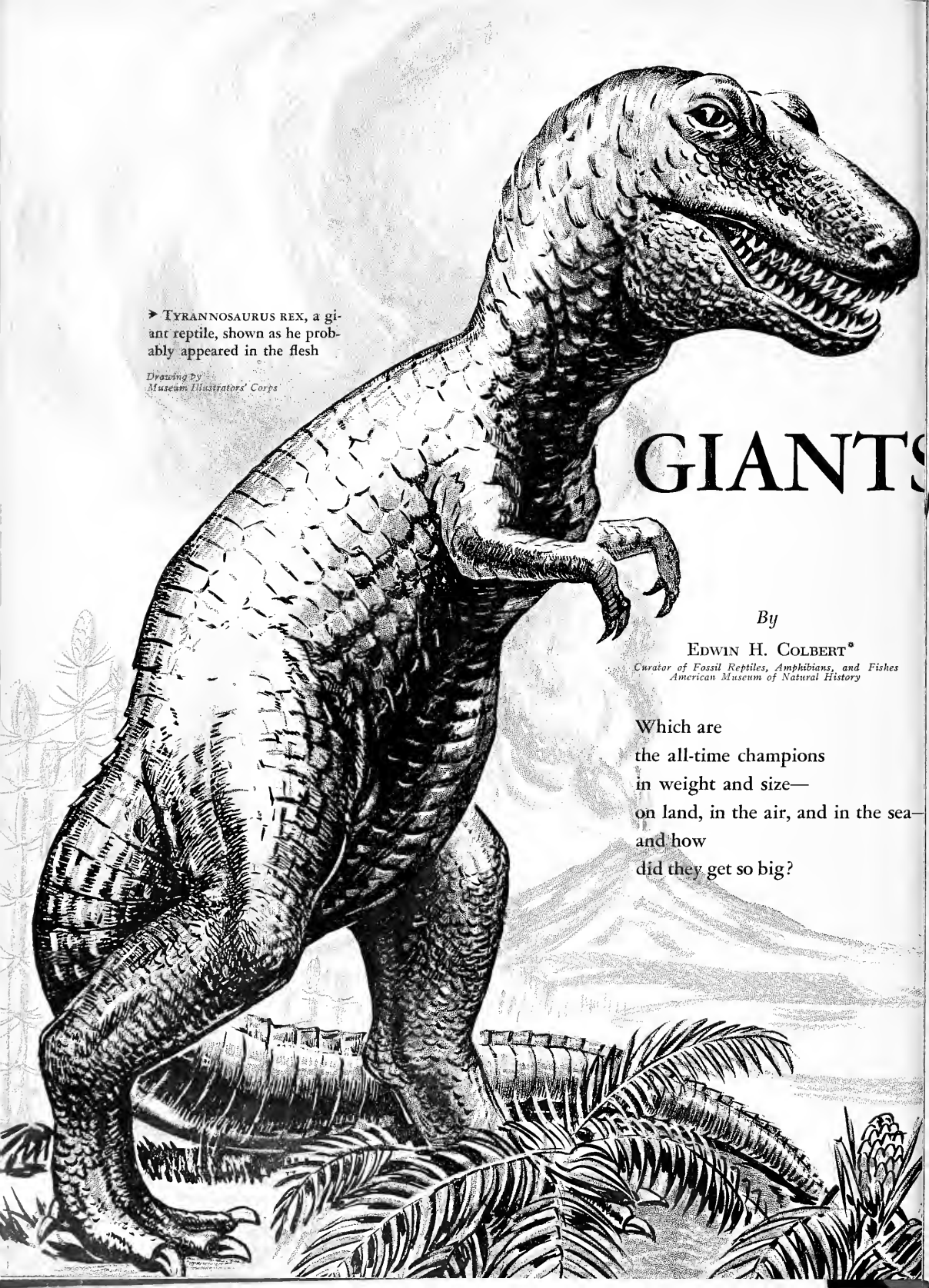
acting is conscious, how much unconscious?

The probable answer to this baffling problem is as surprising as the possum-playing performance itself. It can be found in the December, 1945, issue of *NATURAL HISTORY*, in which Dr. Frank A. Beach, now Professor of Psychology at Yale University, discusses the so-called hypnotic trance in animals. Dr. Beach considers it possible that the death-feigning phenomenon is a "variant of *tonic immobility*." This is the term used to designate the state induced in certain animals when they are suddenly turned upside down. The animals so treated "remain relatively motionless for varying periods of time" and "fail to show any response to many stimuli that ordinarily would elicit a definite reaction . . . It is suspected," he continues, "that this treatment causes the release into the circulatory system of specific glandular secretions, and that these hypothetical chemical agents paralyze certain higher nervous centers of the brain." Apparently the inverted position assumed by the hog-

nose snake when frightened or molested results in the same paralyzing effect. Hognose simply passes out.

It has been inferred that, because the condition of tonic immobility usually persists in any given animal for a definite and relatively unvarying time, the creature comes to only after the paralyzing glandular secretion has worn off. However, one wonders whether this can hold in the case of the hognose snake, because if you try to turn your passed-out snake right side up, it almost invariably turns upside down again. Moreover, there is no reason why a snake that has "fainted" should necessarily turn upside down in the first place. So perhaps we have yet to discover the complete explanation.

But in any case, even if our hognose hero does not *act* his tragic pantomime of death but merely *reacts* it, certain it is that if there are any "Oscars" to be awarded in the world of animal acting, the vote of many naturalists will unhesitatingly go to the hognose snake, possum player extraordinary.



► TYRANNOSAURUS REX, a giant reptile, shown as he probably appeared in the flesh

*Drawing by  
Museum Illustrators' Corps*

# GIANTS

*By*

EDWIN H. COLBERT\*

*Curator of Fossil Reptiles, Amphibians, and Fishes  
American Museum of Natural History*

Which are  
the all-time champions  
in weight and size—  
on land, in the air, and in the sea—  
and how  
did they get so big?

EVER since the dawn of history and probably for long ages before that, Man has been a creator of giants. As a result of the workings of his fertile mind, he has built up pictures in his imagination of huge beings roaming the earth, and at times these giants have seemed very real. Giants play a prominent part in legend and folklore, and we are all well acquainted with them from the days of our childhood.

Perhaps some of the tales of giants are not without a background of factual evidence. We know from various accounts that through the centuries Man has frequently (and usually accidentally)

conquered Mexico, mentions confirmation of the existence of giants in his detailed and fascinating account of the conquest. His description, obviously based upon the bones of an extinct elephant or mammoth, is as follows:

"They [the Tlascalcan chiefs] said that their ancestors had told them, that in former times the country was inhabited by men and women of great stature and wicked manners, whom their ancestors had at length extirpated; and in order that we might judge the bulk of these people, they brought us a bone which had belonged to one of them, so large, that when placed

giants that left their bones as visible proof of their former greatness were giant animals of various sorts, and many of them lived long before there were any men to see them. There are giants today, but these beasts are so familiar to us that for the most part we are not astonished at their great size. Some of these giants have lived and do live in the water—giant fishes and swimming reptiles and whales. Others have walked or do walk across the face of the land—giant dinosaurs and mammoths and elephants. As a result of scientific study, these giants are now well known to us, and we recognize them for what they were or are.

What makes a giant? What are

## f the Animal Kingdom

dug up or discovered the bones of large animals long since extinct. Before the birth of the scientific study of fossils, it was quite natural for credulous people (and in those days most people were credulous) to regard such large bones as the remains of giants. So the legends found support in things that were dug out of the earth. There must have been giants on the earth, for were not these the bones to prove their former existence?

Very likely the fossil bones of extinct elephants or perhaps of some of the large dinosaurs were the "proof" by which ancient and medieval Man confirmed his belief in giants. For instance, the Spanish conquistador, Captain Bernal Diaz del Castillo, a trusted and faithful officer in the little band of intrepid adventurers who, under Cortez,

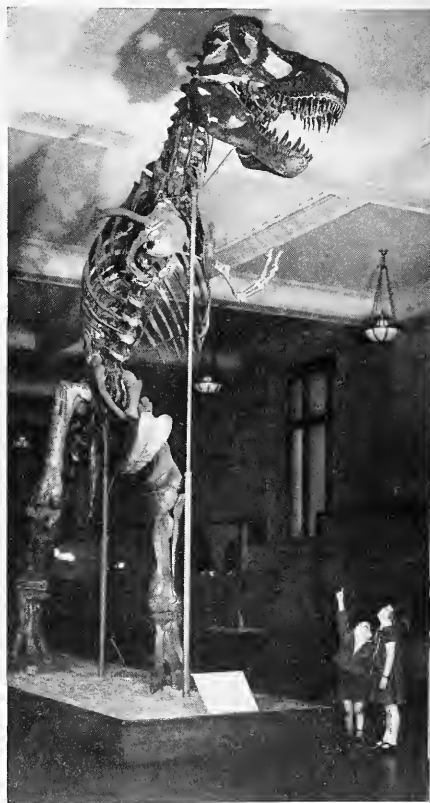
upright it was as high as a middling sized man; it was the bone between the knee and the hip; I stood by it, and it was of my height, though I am as tall as the generality of men. They brought also pieces of other bones of great size, but much consumed by time; but the one I have mentioned was entire; we were astonished at these remains, and thought that they certainly demonstrated the former existence of giants." †

Let us make a respectful bow to the legends and imaginary tales of the past and turn to the hard scientific evidence of the present day. From such evidence we know that there have been and still are giants on the earth but not giants of the fairy tale variety. The vanished

†Bernal Diaz del Castillo—*The True History of the Conquest of Mexico*. Translated by Maurice Keatinge. New York, 1927, Robert M. McBride and Co., p. 143.

\*EDWIN H. COLBERT has been studying fossils and looking for them for something more than 20 years. During that time he has described fossil mammals and reptiles from North and South America and from India, China, Mongolia, and Africa. At present, he is especially interested in the reptiles that inhabited the earth at the beginning of the Age of Dinosaurs. Two years ago, part of a claw of a small dinosaur, a fragment no larger than one's fingertip, led him and his associates to a deposit in New Mexico from which they obtained a large and re-

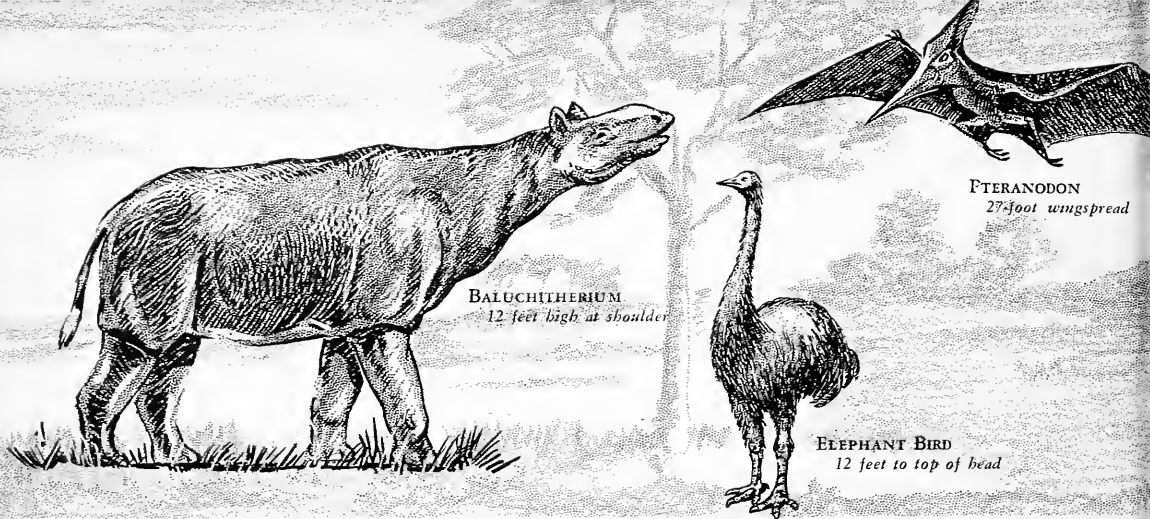
markable series of fossil skeletons of primitive dinosaurs. (See "The Little Dinosaurs of Ghost Ranch," *NATURAL HISTORY*, November, 1947.) Dr. Colbert has written a number of articles for *NATURAL HISTORY*, and he is the author of *The Dinosaur Book*. He was graduated from the University of Nebraska and completed studies for his higher degrees at Columbia University. He is now a Curator at the American Museum of Natural History and Professor of Vertebrate Paleontology at Columbia University.—Ed.



AMNH photo

▲ THESE TWO will never reach Tyrannosaurus' great height of 20 feet, but man's outstanding achievement is in the realm of intellect. No other creature has approached his capacity for curiosity and independent thought





BALUCHITHERIUM  
12 feet high at shoulder

PTERANODON  
27-foot wingspread

ELEPHANT BIRD  
12 feet to top of head

the advantages and the disadvantages of being a giant? If some animals could achieve giantism, why did Man never become a giant?

The three general habitats for giants, as for all other life are, of course, the water, the earth, and the air. The largest giants have been and are water-living animals. Throughout the long history of the earth, giants have been common on the land; but the largest land giants have never been as large as the aquatic ones. On the other hand, giants in the air are comparatively rare. There seems to be no limit to the ultimate size of man-made flying machines. but for flying animals

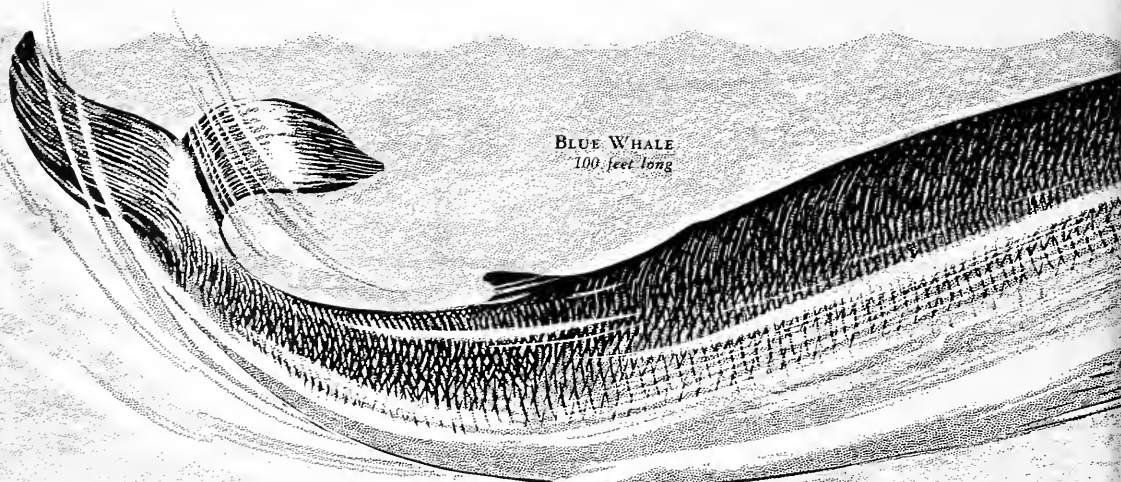
the limits are very rigid. Even the largest of the flying animals are hardly giants at all when compared with the giants of the earth and the water.

One of the greatest disadvantages of being a giant is the ever-present problem of gravity. The bigger an animal is, the stronger it has to be to support its weight against the pull of gravity. Consequently, there are definite and absolute limitations to the size of animals, depending upon their anatomical structure and their habitats. Bone and ligament and muscle all have definite physi-

cal properties. They have definite tensile and compressive strengths, beyond which they are torn apart or shattered. It is obvious, therefore, that animals cannot grow to a size beyond which their bones, ligaments, and muscles are able to support them.


As an animal grows in length, it grows much more rapidly in mass. Generally speaking, if one animal is twice as long as another, it is about eight times as heavy. In other words, the increase in mass is the cube of the increase in length. For instance, if a box one foot wide,

ON THE LAND, in the air, and in the sea there have been giants, but those in the water have attained the greatest size, because their medium is most favorable to their growth




BLUE WHALE  
100 feet long





EXTINCT VULTURE  
12-foot wingspread



FLYING FOX  
5-foot wingspread



BRONTOSAURUS  
70 feet long

one foot high, and two feet long is increased so that its dimensions in each direction are double, it will hold not twice the weight of material that it originally held but eight times as much. The increase in size in animals is not as simple as this, but the principle is the same.

Of course, bones and ligaments and muscles increase in bulk as the animal increases in size, but their strength is not exactly proportionate to their bulk. Rather, the strength of a bone is more nearly proportionate to its cross section. Just as

the mass of an animal increases much more rapidly than its length, so it increases more rapidly than the strength of the supporting members. These are some of the basic facts that determine the limits of size in animals.

Now, an animal that lives in the water is not a victim of gravity as is the land-living animal. It is buoyed up by the water in which it lives, which opens to the aquatic animal a path to greater giantism.

The land-living animal, on the other hand, is engaged in a constant

if unconscious fight against the downward pull of gravity. It is not supported by the medium in which it lives, but rather it must provide its own support. Consequently, although the land-living animal can attain a considerable size, it can never grow as large as the water-living animal.

With flying animals, the limits to size are very restricted. When in the air, the flying animal must pit the absolute strength of its muscles against its weight. While its weight increases in proportion to the cube



PLESIOSAUR (*Elasmosaurus*)  
40 feet long



WHALE SHARK  
45 feet long

of its length, its muscular strength is more nearly equal to the square of its size. Therefore, there is not enough muscle power available to carry a large, heavy animal through the air.

Other factors enter into this problem of giantism, factors of physiology, temperature controls, and food supply. They point up not only the limitations and disadvantages of giantism but the advantages as well—for there are certain advantages in being a giant. But to keep from getting too deeply involved in a complex problem, let us limit this consideration to that of weight alone. In view of the problems of weight, what were and are the giants in the animal world? How do they appear in the record of life on the earth, and what have been their relationships to the animal world around them?

It is evident that giants cannot be defined easily, whether they live or have lived in the water, on the land, or in the air. There have been giants among the backboned animals, or vertebrates, and giants among the animals that do not have backbones, the invertebrates. In fact, that symbol of spinelessness, the jellyfish, has entered the contest and produced the champion in linear dimensions—a jellyfish with tentacles longer than any whale. Different criteria for the definition of giants must of necessity be applied, according to the relationships of the animals under consideration or the habitats in which they live.

Since this discussion must have some boundaries, the giants herein considered will be those with backbones. They will be the giant vertebrates. Among the vertebrates the giants will be defined, quite arbitrarily, as those animals having at least one body dimension measuring ten feet or more and, except for flying animals, a weight of at least several hundred pounds.

The earliest giants among the vertebrates or backboned animals were giants of the sea. They appeared at an early stage in vertebrate evolution, some 350 million years ago in the Devonian period

of earth history. They were huge, fishlike creatures that swam in the waters of estuaries that indented the coast lines of those distant days. These giant arthroires had tremendous heads, with widely gaping jaws armed not with teeth but with bladelike, bony plates that functioned in a manner similar to teeth. From the great head the body tapered back to a rather sharklike tail, while just behind the head was a pair of rather small fins, one on each side. The largest of the arthroire giants attained a length of 30 feet, and they probably reached a weight of 10 tons or more. These arthroires did very well in their day and evidently were the rulers of the waters in which they lived.

At the end of Devonian times the arthroires became extinct, and the "true" fishes, already developing rapidly during the Devonian period, became the dominant vertebrates of the waters. Since then, during the long history of the fishes, giants have frequently appeared, and some of them are still with us. Millions of years ago there were trends toward giantism among the sharks, as indicated by the mute testimony of fossil shark teeth of great size. Evidently the ancient sharks, of which these teeth are the sole remains, must have been 40 or 50 feet in length—so large as to make most modern sharks look puny by comparison. But it should not be thought that all of the giant sharks existed in past times, because there are still giants, such as the basking shark, and more particularly the whale shark, one of the largest of all fishes, past or present. A big whale shark will measure 45 feet in length and have a weight of more than 13 tons.

There have been giants among the bony fish, too, but none of these measure up to the shark giants. A fish known as *Porthus*, which during the age of dinosaurs swam in the shallow, mediterranean seas covering what is now the state of Kansas, was a giant with a length of some fifteen feet and a probable weight of more than a ton. It was a big fish, but giants of somewhat lesser size are still to be found

among the bony fishes of today, fishes such as the tuna and the swordfish.

Among the air-breathing vertebrates, any trends toward giantism soon ran into serious and numerous complications. The ever-present problem of gravity, together with attendant problems of physiology, food supply, and the like have made the way for the land giant a difficult one indeed. It is interesting, therefore, to see that among the air-breathing vertebrates giantism reaches its extremes in those animals that returned to the water to live.

For instance, during the age of dinosaurs three groups of reptiles became adapted to a completely aquatic mode of life. These were the ichthyosaurs, the plesiosaurs and their relatives, and the mosasaurs. The ichthyosaurs became secondarily very fishlike—streamlined animals with a propelling tail and with the limbs transformed into balancing fins or paddles. Some of these ichthyosaurs became rather large, but none of them were real giants, the largest being of a size comparable to some of the modern porpoises. The plesiosaurs and the mosasaurs, however, did reach the proportions of giants. The plesiosaurs were long-necked, short-bodied reptiles that rowed themselves along the surface by means of oarlike paddles, and some of these reptiles, especially those living in the Cretaceous period, were very large. The mosasaurs, which were nothing more than seagoing lizards, evolved into veritable monsters, reaching a length of 30 feet or more.

But no other water-living animals have ever equaled or even approached the huge size of some of our modern whales. These are the real giants of all time. Whales 60 feet in length, with a weight of about 60 tons, are not uncommon, while some species and genera such as the great Blue Whale reach almost unbelievable sizes. Blue Whales have been recorded with a length of almost 100 feet and a weight up to 150 tons.

The bodily transformations that

have taken place during the evolution of the whales into giants from their ultimate land-living ancestors have indeed been profound. These air-breathing mammals have become thoroughly aquatic, and so large are they that the bones, muscles, and ligaments are no longer able to support the weight of the body. In the water this is no problem, but when whales become stranded in water too shallow to float them, they soon die of suffocation. The weight of the body crushes the air out of their lungs.

Other giants have evolved among the mammals that returned to the sea, giants such as the sea elephants and the sea cows. But these are giants of a fairly moderate sort, and the whales remain the supreme example of giantism in the entire evolutionary picture.

Dinosaurs have already been mentioned, and these are known to almost everybody as the giants of the past. Here we see land animals solving the problems of being giants. Here we see what happens when the trend toward giantism runs full force into the law of gravity. The law is inexorable, and the evolving giants must adapt themselves to the law.

The largest dinosaurs were the great sauropods, the brontosaurus, measuring from 60 to 80 feet and probably weighing 30 to 50 tons in life. It is very likely that these figures represent the upper limits attainable for land-living animals—the limits beyond which bone, ligament, and muscle are of insufficient strength to support the great weight of the body. And in these huge dinosaurs we can see the adaptations that took place to make structurally possible these largest of land animals.

Thus, in the great dinosaurs the legs were enormously heavy and straight, and the bones were very strong and dense. The legs formed veritable posts or pillars for the support of the animal. The backbone, on the other hand, while strong, was lightly constructed. There were complex articulations between the individual bones of the spinal column to make them

interlock more firmly, but the vertebrae themselves were hollowed-out structures in which bone was present only where needed and absent where not essential. Great size was therefore attained without the addition of undue weight in the vertebral column. The sauropod dinosaur skeleton can be thought of as a strong truss supported on heavy abutments.

The dinosaurs were not the only giants among land-living reptiles. Even before the dinosaurs there were giant reptiles, especially certain crocodile-like reptiles known as phytosaurs, living 165 to 205 million years ago in the Triassic period. Yet compared with the larger dinosaurs, the phytosaurs were beasts of modest proportions, and the problems of giantism were not so serious for them as for the huge dinosaurs. There were the crocodiles, too—giants that still survive into our modern world. Here again, even the largest crocodiles have been spared the most difficult problems of being a giant on land.

After the dinosaurs became extinct, some 60 to 70 million years ago, the mammals became dominant on the earth, and trends toward giantism were repeated. Among the land-living mammals, certain groups evolved into giants, notably the great titanotheres of the Oligocene period (28 to 39 million years ago), the rhinoceroses, the hippopotamuses, and the elephants and their relatives. Of these various mammals the elephants and their relatives have throughout their history been the foremost of the land-living giants. They began their evolutionary history with an early trend toward great size, and this trend developed rapidly to produce long-nosed, tusked animals that ranged far and wide over the earth during much of the Age of Mammals. In evolving as giants, the elephants followed certain lines of structural development more or less similar to those followed much earlier by the giant dinosaurs. For instance, the elephants developed straight, heavy, postlike legs to serve as pillars for support of the body. But whereas the largest di-

nosaurus attained probable weights of 40 or 50 tons, the largest elephants, past or present, have probably never exceeded 8 or 10 tons. Consequently, adaptations to giantism in these mammals have never been as profound as in the dinosaurs.

In general, the titanotheres, rhinoceroses, hippopotamuses, and other giant mammals have been reasonably modest rivals of the elephants, but there is one exception. This was a giant rhinoceros that lived in Asia during the Miocene period, some 20 million years ago. It is known as *Baluchitherium*, because it was first discovered in Baluchistan. *Baluchitherium* was truly a monster mammal, standing eighteen feet in height at the shoulders. It dwarfs the largest of the elephants, and very probably, like the huge sauropod dinosaurs among the reptiles, it represents about the maximum size to which a land-living mammal can develop.

During the age of dinosaurs the first giants of the air appeared. These were flying reptiles known as pteranodonts, and some of these became quite large, with wingspreads of 18 or 20 feet. Yet although these winged dragons of the air were impressively large, they were not very heavy, and the body was hardly larger than the body of a good-sized turkey. They were mostly wing and lightly constructed. The bones were hollow, to make them light, and there were large attachments for flight muscles. The pteranodonts were giants only in dimensions, not in mass.

The birds, too, have evolved their giants. The "giants" among the flying birds are the vultures, condors and eagles, the cranes and other wading birds, swans, and certain fowls such as the turkeys. Small giants, these. The real giants among the birds have been those that lost the ability to fly and became creatures of the ground. Various giant ground birds are found in the fossil record, and some of them persist to the present day—the ostriches, the emus, and the cassowaries. In these giant birds, as in so many other giants, we see the adaptations

*Continued on page 430*

IN November of 1921 a Canadian fisherman named A. E. Crewe, lifting pound nets off the port of Merlin, Ontario, brought to the top a strange double catch, two fish locked together in what would soon have been, for one of the pair, an embrace of death.

One half of the strange team was a big lake trout. The other was a repulsive looking, eel-like creature, close to two feet long, that was firmly attached to the side of the trout by means of a strong sucker mouth, and it kept its tenacious grip even when taken from the water. When it was forcibly pulled away, it left an eroded, bloody scar patch.

The "eel" looked like nothing Crewe had ever seen before. He took it to Canadian scientists for identification and was told that he had established a scientific record. It was not a record of good omen, however. What the fisherman had captured was the first marine lamprey ever taken in Lake Erie or anywhere else in the waters of the Great Lakes above Niagara.

It was an event of much greater significance than anyone suspected at the time. That first lamprey was a sort of advance scout, the forerunner of an invasion of these giant bloodsuckers into the upper Great Lakes, and likewise a forerunner of almost unbelievable disaster for the lake trout, whitefish, and other food fishes of those waters. As will be seen later, it was a dynamic illustration of how a small act on the part of man can create a conservation problem of tremendous proportions.

It is no longer novel, in Lake Huron, Lake Michigan, or even Lake Superior, for commercial fishermen to bring up in their nets fishes bearing lamprey scars or fishes with live lampreys attached. Lake trout, whitefish, herring, chubs, pickerel, suckers, carp, perch, and catfish, marked with one or more big eroded patches on throat, side, or back, are an everyday catch in the Great Lakes now.

Fishermen in Lake Huron have reported in recent years that as many as 90 out of each 100 trout

# Is the Lake Trout DOOMED?

When man enabled the sea lamprey to spread through the Great Lakes, little danger was foreseen, but in 12 years the trout catch in the United States waters of Lake Huron fell from 1,720,000 pounds to only a little over 2 tons

By BEN EAST

caught show lamprey scars. In Lake Michigan from 50 to 70 per cent of the trout catch is marked at the present time. For the most part it is the larger fish that display the scars, because the lamprey is more inclined to attack the larger ones, and also the smaller ones are less able to survive the attack. In Lake Michigan, 80 per cent of the trout catch over 2 feet long is scarred, but a marked trout under 17 inches is a rarity.

Many fish carry two or three scars. As many as nine have been recorded, each as big as a silver dollar or bigger. The scar may be healed over or it may be fresh and raw, still oozing blood. It may be shallow, penetrating only through scales and skin, but more often it goes all the way through the body wall into the belly, leaving a dreadful gaping wound. And for each victim that survives, probably hundreds, perhaps thousands, die unrecorded in the depths of the lake from the terrible blood-letting of the sea lamprey!

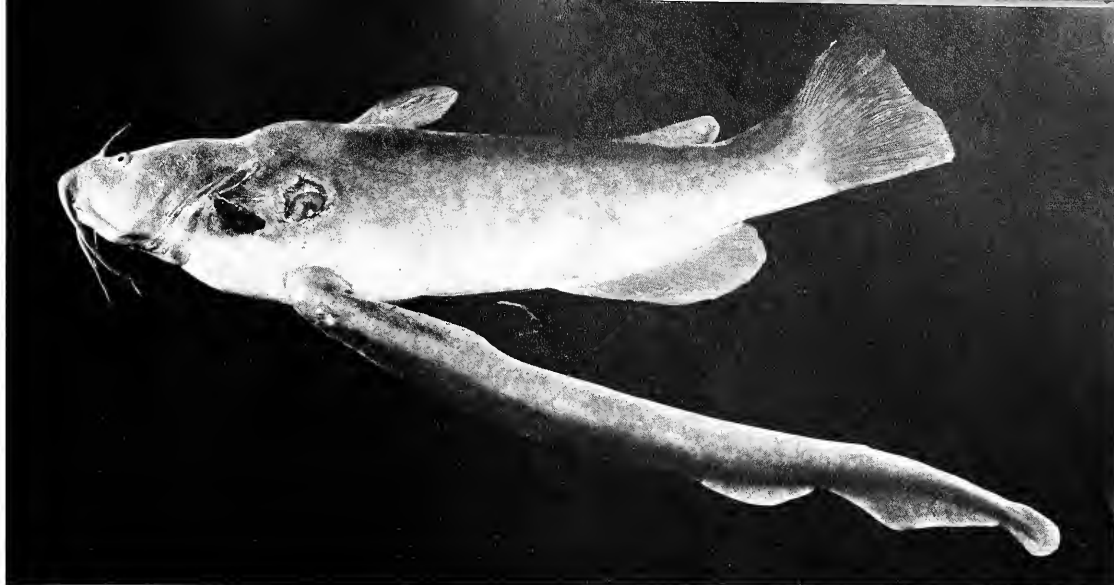
When the November gales stirred Lake Michigan last autumn, fishermen lifted nets that sagged with dead and decaying trout. That carrion catch, rolled into the twine by the storm-disturbed waters far down on the lake bottom, was indisputable proof of the toll taken by the lampreys. To load the nets in such a fashion, experts say, there

must be areas where the floor of Lake Michigan is literally paved with decomposing trout that have died from lamprey attack!

The results of the lamprey invasion show, with dramatic and tragic clarity, in the record of the trout catch for Lake Huron and Lake Michigan.

Around 1936, the lampreys became firmly established and plentiful in Lake Huron, the first of the Great Lakes to feel serious effects from them. At that time the United States waters of the lake were producing an annual catch of 1,720,000 pounds of trout, the average figure for the previous 40 years. From 1936 on, the take dropped at a steady and alarming rate year after year, until it reached the incredibly low total of less than 5000 pounds in 1948.

It is hard to believe that the American waters of Lake Huron, once one of the foremost lake trout grounds in the world, produced only a little more than two tons of these fish last year, but such is the case. Trout are virtually nonexistent on those grounds today, and the situation on the Canadian side of the lake is only a very little better. For 30 years prior to 1940, the Canadian waters of Huron yielded an average annual take of close to 4,000,000 pounds of trout. Then the lampreys began their work, and the catch hit the skids. Each



*AMNH photo*

▲ THE SEA LAMPREY attaches itself by means of its rasping sucker, as shown in this model of a catfish in the

American Museum. Millions of valuable food fishes are killed each year by this marauder

*Mich. Department of Conservation photo by W. E. Hastings*

year since has set a new low record, and the catch now is down to less than 400,000 pounds annually, one-tenth of what it was in 1940.

The lampreys moved into Lake Michigan more recently. The first record for that lake was in 1934, and only in the last five years have they reached numbers sufficient to affect the trout catch. But they are reducing it now at a rate that threatens to wipe it out in a few more years. For the 5-year period from 1939 to 1944, Lake Michigan's trout production averaged around 6,500,000 pounds annually. Since that time it has fallen at the rate of about 1,500,000 pounds a year, until last year it totaled only a little more than 1,000,000 pounds.

The lampreys have only recently reached Lake Superior, but no one who is familiar with the situation has any doubt as to what is going to happen there from now on.

It seems inevitable that the lake trout, one of America's most popular food fishes, must disappear entirely from our tables within another decade or two unless a way is found to cope with the lamprey problem.

"The sea lamprey," declares John Van Oosten, chief of Great Lakes fishery investigations for the United States Fish and Wildlife Service, "is giving lake trout fishing in the

IS THE LAKE TROUT DOOMED?

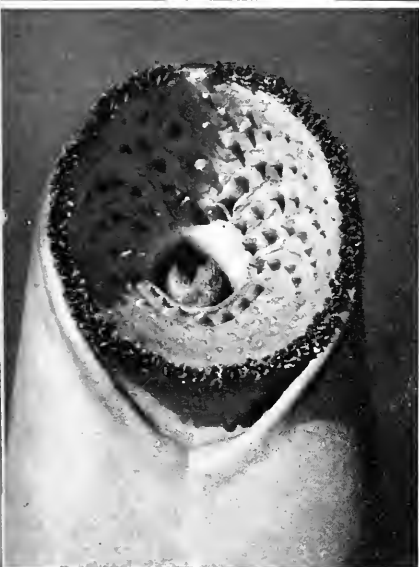


▲ AN OFFICER of the Michigan Department of Conservation dipping a netful of sea lampreys from the spawning beds. Each female lays an average of 62,500 eggs!



AMNH photos

▲ THE SEA LAMPREY, sometimes 30 inches long, "swims like a snake and looks like a length of garden hose." Its bluish-gray is mottled with yellowish or brownish blotches during spawning



Great Lakes its final blow toward extinction!"

Nor is that all. What will happen after the lake trout has disappeared, as it now seems certain to do in a few more years, no one can predict. But those who have studied the lamprey do not believe the giant bloodsuckers will lie quiet on the lake bottom and die of starvation, so long as there are other fishes in the water to be attacked!

Up to now they have displayed a marked preference for lake trout, perhaps because the small scales of the trout render it particularly vulnerable. But the lamprey does not hesitate to attack other fishes, even under present conditions. Its preference after trout, in the Great Lakes, is for whitefish, suckers, pickerel, and carp, in that order. It seems a foregone conclusion that once the trout are gone the lamprey will turn its attention to other species, wiping them out one after another, unless some method is

◀ WITH this efficient circular rasp, the sea lamprey attaches itself to its victim and feeds on it. The scar it makes is about the size of a silver dollar

found in the meantime of eliminating the lamprey itself.

Small wonder authorities in both Canada and the United States declare that unless the lamprey menace is brought under control the fishing industry of the Great Lakes, worth \$12,000,000 a year to the fishermen themselves, is facing almost certain ruin. The ghost-town specter hangs over many a thriving fishing port along the coast of Ontario, Minnesota, Wisconsin, and Michigan today and as yet is largely unrecognized.

For the sea lampreys give every evidence that they are going to be a tough pest to control or eradicate. In two years of persistent effort, scientists and fish culturists have made little headway toward finding effective ways of waging war on them. It is generally conceded now that they have gained such a foothold in the Great Lakes that there is no possibility they can ever be eliminated. The best that can be hoped for, apparently, is that natural checks will ultimately halt the rising curve of the lamprey population, until continued research can turn up control measures to hold down the lamprey throng and reduce to a minimum the amount of damage, as the damage done by many insect pests is now kept in check. Even that goal, however,

promises to be extremely difficult to attain in the case of the sea lamprey.

The lamprey is a primitive fish and was originally found only in salt water, spawning in streams along the coasts of both North America and Europe. Many years ago it moved in from the sea to establish itself in a smaller or dwarf form in Lake Ontario and the Finger Lakes of New York. But until 1921, the thundering barrier of Niagara barred the lamprey host from the upper Great Lakes. It was man himself who unwittingly helped the creatures around that barrier.

The lampreys first gained access to Lake Erie by way of the Welland Canal, although no one knows whether they came under their own power or hitchhiked in by attaching themselves to the bottoms of ships, a common habit of theirs. Experts believe new invasions may still be making their way into Lake Erie annually, coming by that same route, to reinforce and swell the ranks of the teeming host already firmly established as far away as western Lake Superior. But curiously enough, although they were first discovered in Erie and must have passed through that lake to reach their present centers of abundance farther from the sea, they have never established themselves there in sufficient numbers to do major damage to the commercial fishery. The reason may lie in the fact that Erie has relatively few areas of deep water, which lam-



preys appear to require, or that it does not offer them tributaries suitable for spawning. Whatever the reason, the lamprey population in Lake Erie has remained below the danger point as far as the food fishes of the lake are concerned.

The spread of the big blood-suckers from their original colony there was not long delayed. The second Lake Erie occurrence was recorded off Sandusky in 1927. Then, in 1930, lampreys were taken from the St. Clair River, linking Lake St. Clair and Lake Huron, and scientists realized the marauders were on the march. Four years later they had swarmed north through Lake Huron and the Straits of Mackinac into Lake Michigan, and that same year the first spawning run was reported in the Clinton River at Rochester, Michigan. The year 1936 saw a lamprey taken in Lake Michigan 15 miles offshore from Milwaukee, and the following spring a heavy spawning run was discovered in the Ocqueoc River, running into Lake Huron 200 miles north of the Clinton. The spread and increase of the creatures has been steady and rapid ever since, and when the first record came in from Lake Superior in 1946, fishery experts knew that the thing they had foreseen and dreaded all along had taken place. The marine lamprey was now established in all of the Great Lakes. From the fact that

the Lake Superior specimen was a small adult attached to a lake trout caught off Isle Royale, only a few miles south of Port Arthur, it seemed likely that the lampreys had then been present and spawning in Superior for several years, too, their presence suspected but unproved.

It is now known that there are spawning runs of lampreys in 108 Michigan streams, in every watershed in the Lake Michigan basin, every major watershed north of Saginaw Bay in the Lake Huron basin, and in 5 tributaries of Lake Superior, including a major run in the Tahquamenon River, the "rushing Taquamenaw" of the Hiawatha legend. In addition, they have established themselves in four of Michigan's larger inland lakes, Burt, Mullet, Pentwater, and Charlevoix, where they pose the same threat to bass and other game fishes as to commercial species in the Great Lakes.

Lamprey spawning runs also are annual events now in many Wisconsin streams running into Lake Michigan north of Manitowoc and in several rivers in Ontario in the Georgian Bay area. In 1948, the first Indiana run was reported, in Trail Creek near Michigan City. And last April lampreys were found for the first time in branches of the Little Calumet River, a northern Indiana stream that drains into the

Mississippi! They had gained access through a drainage ditch leading in from Lake Michigan. From there the entire Mississippi watershed is theirs to invade if they choose. Whether they will take advantage of the opportunity and spread through this vast new range only time will tell. But at least they have succeeded in vaulting the natural barriers between the Great Lakes and Old Man River.

Few creatures of the underwater world are more repulsive in appearance or better fitted to pursue a predatory way of life. Ranging in length from 14 to 30 inches, averaging 15 to 18, the lamprey is long, slender, and to a Great Lakes fisherman the symbol of evil. "If it swims like a snake and looks like a length of garden hose, it's a sea lamprey," was the descriptive phrase one research worker coined for the creature a few years back.

The fish has a smooth, scaleless, slimy skin and two short, separate dorsal fins. The ground color of a mature adult is bluish-gray, and in spawning season the lampreys are strongly mottled with yellowish or brownish-orange blotches. A row of seven round gill openings is arranged along each side of the throat like small portholes. The flat "low-brow" head ends in a round sucker mouth rather than in true jaws. The inside of this sucker disc is armed with sharp, strong teeth which the creature uses, together with its file-like tongue, to rasp away the scales, skin, and flesh of any fish to which it attaches itself. Once the skin is lacerated and the blood starts flowing, a secretion from glands in the lamprey's mouth prevents clotting. The big bloodsucker rides along, feeding on its helpless host, until it has its fill of blood or the victim dies from the attack. The lamprey's period of attachment varies from a few hours to a week, and often it goes on clinging to its host for a time after the latter is dead.

Legend has it that the lampreys were once looked upon as a table delicacy, and Henry I of England is said to have died from eating too many of the creatures. In the Baltic countries of eastern Europe they

▼ WEIRS like this one in the Ocqueoc River, to trap the lampreys as they go upstream to spawn, seem to offer the best hope. But the task is tremendous, and there seems little chance that the lamprey can ever be eradicated

*Mich. Department of Conservation photo by W. E. Hastings*



are still used for food, and before the recent war Finnish immigrants in northern Michigan were importing canned lamprey. To date, however, nothing has come of experiments aimed at utilizing for food Great Lakes lampreys captured on the spawning run.

In 1946, Congress passed a resolution directing the Fish and Wildlife Service to undertake a sweeping investigation of the lamprey and push a program for its eradication. In November of that year the Sea Lamprey Committee, organized by the Service and including conservation officials from Ontario and all of the states bordering on the Great Lakes, got together to map out a campaign.

The lamprey war got under way the following spring, with Michigan, Ontario, Wisconsin, and the Fish and Wildlife Service taking the lead. So far, in two years of study, much that is new has been learned about the lamprey's life history. But to date all attempts to find workable ways to thin his ranks have come to a dead end.

It is fairly well established now that the life cycle of this marine pest ranges from five and a half to six and a half years. The first four or five years of its life are spent in a larval stage in the stream where it is hatched. After hatching, in early summer, it remains in the nest for about a month, by which time it has grown to a length of half an inch. It then moves downstream and burrows into beds of sand or silt for a long, slow period of development. At this stage it does no damage. It looks like a worm and feeds on microscopic organisms carried to it by the current. Growing slowly, it reaches a length of six to eight inches at the end of its fourth or fifth year and is then ready for a metamorphosis that will transform it into the adult, blood-hungry form, much as a tadpole is transformed into a frog.

The eyes develop, the sucker disc is formed, the stout teeth appear within it. When it is fully equipped for adult life, the lamprey quits its silt bed and migrates downstream once more, this time to the lake be-

yond the river mouth, where for the rest of its days it will prowl and prey on any unfortunate fish of its choice to which it can attach itself.

The adult life of the lamprey is believed to last at least a year and a half. At the end of that time, sexually mature, it is ready to re-enter a stream for the final climactic act of its life. Males and females move up together, fighting their way toward the headwaters in a wriggling horde, taking advantage of the cover of darkness, hurrying on toward the spawning grounds.

The first spawners enter the streams in April; the last stragglers do not make the journey before July in some waters. The peak of the run occurs in May and early June, however, governed by water temperatures.

Men who have seen a pool or gravel bar crowded with the slimy, slithering bloodsuckers say it is not a pretty sight. It's just as well, they contend, that the lamprey runs occur chiefly at night. But for that same reason, sizable runs may develop in a stream without their presence being suspected, a fact that has made much more difficult the task of determining the abundance of the lampreys in the waters of the Great Lakes.

Once suitable spawning grounds are reached, on gravel bottom with a fairly fast current, male and female lamprey together set about the task of building a nest. Moving stones with the aid of their sucker mouths, they excavate a shallow redd 3 to 6 inches deep and 12 to 30 inches across. There the female proceeds to deposit a mass of eggs ranging in number from 24,000 to more than 100,000 and averaging 62,500—which affords some idea of the magnitude of any practical plan for sea lamprey control!

The adult lampreys die after spawning, as do the salmon of the Pacific. The eggs hatch in one to three weeks, and the cycle starts all over again.

At no point along the line of that unusual life cycle has an effective way been found to attack the lampreys. Thus far there seems to be no weak link in the chain of events

that brings them from egg to full-grown bloodsucker.

The Great Lakes watershed abounds in rivers and small streams that provide ideal spawning places. The lakes themselves provide an abundant food supply. Blessed by a favorable habitat, lacking natural enemies or other natural checks, and apparently free from epidemics such as often kill off overcrowded forms of wildlife (they congregate in schools only at spawning time), the marine lampreys are doing extremely well in their new environment.

Electric shocking devices, such as are used in fish research work, have been tested and failed. Rotenone poisoning also has failed to kill the larvae in the streams. The poisoning of an entire spawning run has not been tried and probably won't be, since to have the desired effect on the lampreys it would have to render the water of the stream deadly to all fish life for a period of four months, at a heavy cost in food and game fish.

The best control method discovered to date, the experts say, appears to be the use of weirs and traps to take the lampreys as they move upstream to spawn. Several such weirs are now in operation in Michigan, Wisconsin, and Ontario, and it is believed that by the efficient operation of these devices it may be possible to wipe out the spawning run in a stream almost completely. In view of the number of streams where runs are now known to occur, however, plus the strong likelihood that the lampreys are spawning in many other streams as yet unreported, it is obvious that the task of bringing under control this menace to the fisheries of the Great Lakes will be huge and costly.

The Fish and Wildlife Service recently asked Congress for an appropriation of \$350,000 to continue the work. Even if this amount, and much more, is forthcoming, and even with the continued co-operation of the individual states and Canada, there is little hope at this point that the job can be completed for many years to come.

two groups of palms by their leaf form. In one group, the leaves look like enormous feathers, as in the coconut palm. In the other group, the leaves are fanlike, as in the giant talipot. From the fan-type leaf, palms possibly derive their name, because the leaf divisions radiate out like fingers from the human palm. Another explanation is that the name "palm" derives from the fact that leaves and branches of these trees were carried in the hands of victors in ancient triumphant processions and were bestowed by hand upon the honored one. But as in most flowering plants, real differences between palms exist primarily in flowers and fruits.

One would hardly grow a palm for its flowers. They are inconspicuous and scarcely more attractive than the tiny blossoms of their distant cousins, the grasses. But though small and petal-less, their numbers are legion. The flowers are borne in much-branched, often pendant clusters, which arise from large boat-shaped spathes readily seen just below the leafy crown of most species. A single flower cluster of an average palm measures from two to six feet long, but the enormous terminal flower crown of the Indian talipot (*Corypha umbraculifera*) may easily attain twenty feet in height. Flowers of this palm may number 60 million individuals per plant—real mass production! Conserving energy over a 30 or 40 year period somewhat like a century plant, the impressive talipot, unlike most of its relatives, flowers only once, throwing all its strength into one mighty blossoming splurge. When it has set fruit, it dies. An even more remarkable if yet unexplainable thing about talipot is that in a given region all individuals of this species will flower at

one time in gregarious fashion. In June of 1918, from one observation spot in Ceylon, 200 talipot could be observed in flower.

Palm fruits, in size, color, and structure, are as divergent as the familiar dates and coconuts. They range from the size of a small pea to the great mass of a coconut; and the latter is the biggest seed in existence save for that of a relative, the famous double coconut, or coco de mer, of the Seychelles Islands, whose individual fruits may weigh from 30 to 40 pounds.

Commercially speaking, it is the fruit that is the most important part of the palm plant. Many palm fruits are edible, the nutritive portion usually being the kernel, as in the coconut. But in other types, such as the peach palm, the farinaceous pulp surrounding the seed is the portion in demand. Both the external pulp and kernels of palms are the great sources of palm oils, which are called either pulp or kernel oils accordingly. The strategic importance of palms was brought to the fore in World War II when fats, needed as never before for food and explosives—not to mention their use in the manufacture of soaps, tin cans, and sheet metal—were (and still are) at a premium. Palm oil was scarce because most of it is derived from copra (obtained from the distant and then isolated South Pacific islands) and from the kernel oil of the west African oil palms. Distance has lent enchantment to these products, but it has also caused hardship, and unnecessarily, because in our own hemisphere there have always existed larger concentrations of native oil-yielding palms than anywhere else. Thus we have been "carrying coals to Newcastle." For besides the coconut and African oil palm, both of which are found cultivated in large quantities in tropical America, there are at least 25 other important native oil palms in South America alone. Fortunately, there are signs that our country is now aware of this hemisphere's own wealth of oil yielders, for many

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of these all-American species are now coming to the front commercially. Their native Indian names—babassú, tucum, ouricury, murú-murú, dendé, cohune, corozo, and bacába—to name a few, sound like a voodoo chant. Latin-American countries, particularly Brazil, have begun to take note of their wealth in oil palms, and companies like United Fruit are investigating the possibilities of one of the American tropics' greatest potential export crops.

The economic possibilities in palm culture have mostly centered in the species supplying oil but are not limited to them. We think of cane as the principal source of our sugar supply, yet in the Far East palm trees produce one billion pounds of sugar yearly. More than a dozen sugar-producing palms are known in southern Asia alone; and as many potential yielders probably grow in our own

hemisphere. Sugar-yielding palms are a perennial crop that needs no harvesting as do cane and beets. Like maple trees, these palms are merely tapped for their sugary exudate. It has been said that the world's saccharine palms, if properly tapped, could produce more sugar than all the other sugar-yielding crops combined!

It is easy to see what a wonderful society palms are: they have paraded across the pages of history; they are supplying our civilization with some of its most important plant products; they have long nourished the races of the tropics; and at the same time, they have cloaked the wild and cultivated gardens of those regions with a green elegance unmatched by any other type of plant. Surely they amply fulfill the billing given them by the great botanist Linnaeus, when he denominated them as *Principes* or "Princes" among plants.

### GIANTS OF THE ANIMAL KINGDOM

*Continued from page 423*

for weight-carrying, the development of strong, heavy legs to support the body against the constant downward pull of gravity.

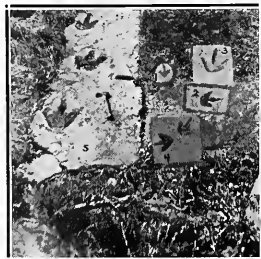
So we see there have been many giants on the earth during the long evolution of life. There have been real giants among the fishes, reptiles, and mammals and lesser giants among other backboned animals. There have been giants in the water and on the land, and giants of a sort in the air. The role of the giant has been tried time and again by various animals, and it has raised its difficulties, the difficulties of sheer mass, physiology, temperature problems, and food supply. But it has given to the giants certain advantages, particularly the advantage of immunity from attack. Giants, because they are giants, are seldom molested except by other giants. Giantism as a way of life, therefore, has been very successful for certain groups of animals.

It should be noted, however, that although various animals have been giants, men, in spite of the proofs offered by Bernal Diaz del Castillo, have never attained the stature of

real giants. Why should this be?

To answer this question briefly, it can be said that Man is a primate, and the primates through their evolutionary history have been tree-dwelling or climbing animals. Because of their mode of life and because of their adaptations to this mode of life, true giantism has been for them something unattainable. Of course there have been giants after a fashion among the primates, and these include Man, the gorilla,

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the orang, and the chimpanzee. But none of the primate giants are real giants like the elephants or the dinosaurs of the past. Therefore, the stories of giant men must remain as legends, to delight us as we read them in fairy tales.

If Man is not a giant in stature,

## BOOKS

Continued from page 391

Dr. Simpson divides his work into three parts. In the first part, which he calls "The Course of Evolution," he makes a brief survey of evolution, especially as concerns the higher vertebrates, with particular emphasis on the reptiles, the mammals, and the primates. The evolution of life through geologic time is briefly outlined, and it is shown that evolution has proceeded at different rates in different lines of animals and at different stages in their histories. Animals and plants have taken advantage of the opportunities open to them to fill the earth with organisms adapted to all manners of existence, and this has resulted in an increase both in variety and numbers.

The second part of the book, "The Interpretation of Evolution," will be of particular interest to students of biology and geology. Such things are discussed as oriented evolution, evolutionary opportunism, racial life and death, forces of evolution, and the concept of progress in evolution. Dr. Simpson rightly rejects all vitalistic theories as to oriented evolution and shows quite clearly that the one factor leading to nonrandom evolution is adaptation. He then goes on to show how evolution is highly opportunistic—how evolving animals utilize the structures that may be developing within their

he has attained a sort of giantism that has never been equaled by any other animals. This is the giantism of intellect. Man is the intellectual giant of all time. He is the inquisitive giant, to whom all the world and its things form a vast puzzle and as such, a challenge. Being a

particular lines, even though these structures may not offer the most perfect mechanical solutions of the functions for which they are adapted. In an illuminating discussion of extinction, he shows that there is no single explanation to account for this phenomenon; rather, extinction is the result of the interaction of changes in environments and changes or lack of changes in the organisms. The forces of evolution are those revealed by the study of modern genetics. There are various definitions and measures of progress in evolution; perhaps the best that can be said is that change toward a particular sort of organism best adapted to its own way of life is the most objective criterion of progress.

In the third part of the book, "Evolution, Humanity and Ethics," Dr. Simpson discusses the moral implications of his work. He concludes that there is no absolute ethic available to Man. The ethical concept is in itself a result of evolution and must be based upon choice in accordance with the mental and moral development of the individual. Dr. Simpson's measure of ethics is based to a large degree upon knowledge and responsibility. The growth of human knowledge and the attainment of a high degree of responsibility are the good things of life.

curious creature with a giant intellect, Man has set for himself the task of learning as much as he can about the world around him. That is how he has learned about the physical giants of the earth, the giants that lived in past ages and the giants of today.

EDWIN H. COLBERT.

## MAINE BIRDS

— — — — by Ralph S. Palmer

Museum of Comparative Zoölogy  
Cambridge, Mass., \$5.00  
656 pp., 3 maps

IN this historical review of the birds of Maine, Dr. Palmer, himself a native of that state, has brought to completion a task begun by the late Arthur H. Norton of the Portland Society of Natural History. The distribution and status, past and present, of Maine birds is very carefully set forth. There is also a wealth of information on nesting habits and general ecology, but this volume is not intended to be a popular handbook and gives no aid in species identification. It will, however, be indispensable to those interested in the birds of Maine.

D. AMADON.

## LETTERS

Continued from page 386

perfidiously snipped the flattened cones with her sharp, kris-edged jaws, and proceeded to regale herself on the nectar secreted nowhere else! The sequence was repeated time after time with practiced precision; so it was not just happenstance but routine procedure. And the mystery of the mutilated flowers was solved!

Never save that once have I seen that highly diverting and thought-nudging performance, nor any evidence of it. There are no witnesses to vouch for my veracity; but most assuredly I am not romancing. It would require an imagination far more fertile than mine to fabricate an incident so nearly incredible yet wholly within the realm of reality. Fact may indeed be stranger than fiction!

Other flowers, notably those of the columbine or honeysuckle, with the nectar at the bottom of the much longer and slimmer spurs, might well tempt an insect to sidestep Nature's rule of reciproc-

cal service; but I have never found their ladders thus rifled.

Her majesty was cheating, of course. And while wrong-doing is never a privilege even of royalty, surely her cleverness ought to extenuate her! Moreover, there must have been plenty of other bees thereabouts to discharge in orthodox fashion the duty she had shirked.

Had she merely stumbled upon that easy short cut to the delectable hoard, which her highly specialized olfactory were unerringly keyed to locate? Or was it a flash of genius, the awakening of individual initiative—dramatic and unique? You tell!

E. P. ANDREWS, M. D.

Portage, Wis.

The following answer is offered by Mr. Herbert F. Schwarz of the American Museum's Department of Insects and Spiders:

The interesting observation recorded by Dr. Andrews is not without precedent. In the Old World, the short-headed Bom-

*bus mastrucatus* employs the same technique in nibbling its way to the nectar deposits of *Aconitum lycoctonum*, while in America there are at least two bumblebees—*Bombus affinis* and *Bombus terricola*—that also secure nectar in this illegitimate manner. Both of these species are characterized by an extremely short head coupled with a short tongue. Because of their structural inadequacy, they cannot readily secure the nectar of long-tubed flowers in the usual manner but are forced to perforate them. That the habit of chewing a passage to the nectar is correlated with the length of the tongue receives support from the observations of the late Otto E. Plath, who noted that



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the workers of *Bombus affinis* perforated the flowers of red clover whereas the longer-tongued queens of the same species as a rule obtained the nectar of the red clover in the approved way. The same observer noted, however, that queens and workers of *affinis* and of *terricola* would in some instances pierce the flowers of rhododendron even though other members of their caste and species were securing nectar without doing violence to the bloom. Here there was persistence in a habit formed under necessity even after that necessity had ceased to exist.

The nefarious habit of mutilating plants in order to drain them of their nectar is not wholly confined to the bumblebees. Among the stingless bees (Meliponidae) of the tropics, *Trigona (Trigona) ruficus*, which occurs in Brazil and in Paraguay, has been accused by both H. von Ihering and Marianno of perforating the area of the plant where the nectar is located. Although *Trigona (Trigona) fulviventris* has not been observed "jimmying" its way into the floral treasure room after the manner of the burglarly *ruficus*, it is not reluctant to share the nectar that such acts of house-breaking make available. Dr. J. C. Bequaert wrote me that in Guatemala he observed *fulviventris* stealing the nectar of the cultivated coffee plant through perforations in the tube of the corolla that had been made by some other despoiler. Even the highly reputable honeybee sometimes becomes an accessory after the fact by lapping up the residue of liquid left after the forcible entry of an earlier visitor.

### Conservation at Lake Success

WHAT may well be regarded in years to come as the most important world conference to date took place at Lake Success during August and September. At the invitation of the Social and Economic Council of the United Nations, over 700 scientists from over 50 countries gathered to discuss the techniques for achieving wise resource use. Over 500 scientific papers were prepared for the Conference and distributed to the participants in advance.

Much of the work of the Conference was carried on in section meetings devoted to special phases of the problem, such as those relating to fuels and energy, water, forests, land, wildlife, and fish. Having read the papers in advance, the participants were free to devote all their time to a discussion of the more baffling aspects of the various problems raised in

the papers. One of the most interesting aspects of these discussions was the great similarity in conservation problems the world over. The United Nations' superb facilities for conference work did much to facilitate the free interchange of ideas and largely erased the usual language barriers.

Out of the Conference will come a set of transactions available in several languages in which will be reproduced both the papers submitted and the discussions concerning them. These transactions will be available to all who are interested in the problem of resource use and will represent the Conference's main accomplishment.

The broader problems of world resources were covered at plenary sessions. These highlighted the question of how the world was going to feed its anticipated three billion population in the year 2000. They also brought out the disturbing fact that our American high standard of living requires for its maintenance such huge quantities of relatively scarce and nonrenewable resources like copper, nickel, zinc, and lead that we are sucking in a large part of the total world's supply—a supply that would last only a matter of one to five years if the whole world were drawing on it at the rate we are.

Although not authorized to pass any resolutions or reach any final conclusions, the Conference made it abundantly clear that the real problem does not lie in the realm of science and conservation technique, but in the fields of politics, economics, and sociology. The world's scientists are well advanced in the task of learning how to handle the lands that produce our renewable resources so that they will be at least as productive a half century from now as they are today. They also had many suggestions concerning the more complete extraction of scarce metals from ore bodies, the more efficient salvage and re-use of such metals, and the wisdom of forcing the use of substitutes before the present ore deposits are exhausted. Even in the marine resources that are used by all and therefore have been no one's responsibility, some progress has been made.

Unfortunately, there was a notable absence at the Conference of those who could suggest how the people and nations of the earth could be induced to put modern conservation techniques into practice in time to save the not inconsiderable portion of the earth's cultivated land that will no longer be producing by the year 2000 if present rates of erosion and exhaustion of fertility are not promptly checked.

Concurrent with the Conference at Lake Success on the conservation and utilization of resources, UNESCO and the newly formed International Union for the Protection of Nature held a conference on nature protection. The very fact that a world conference on such a subject

was called under UN sponsorship was a great achievement. For years, small groups in almost every country have been fighting what has often seemed a hopeless battle to save some remnant of the world as nature made it. For representatives simply to meet each other face to face to exchange views and experiences and plan for the future was an inspiring experience.

This Conference was less bound by limitations than the larger one and in a sense was more realistic, as much of its attention was devoted to the need for public education on the subject of nature protection. At its final session an excellent set of resolutions was formulated and adopted. At the various section meetings attention was directed to the need for more basic ecological research and more attention to the over-all effect on the environment of large-scale "planned enterprises." At a meeting on the problem of exotics there was complete unanimity of opinion on the inadvisability of introducing any plant or animal into an area where it had never been present and therefore had never had a chance to evolve a harmonious relationship with the other organisms of the area.

Several meetings were devoted to the problem presented by the larger mammals, and methods were considered whereby they might be preserved in an increasingly civilized and densely populated world. Attention was also given to the problem of how at least samples of all the primitive world's rich fauna and flora could be saved for future generations.

The 22 resolutions passed by the Conference highlighted these problems and called upon the various national governments and UNESCO to give wider recognition to them. Unfortunately, the International Union for the Protection of Nature, co-sponsor of the Conference, and the one organization that might follow through on these matters on an international scale, is still without the financial means even to stay alive.

The Conference made it clearer than ever that the impact of our modern technological civilization on even the most remote, out-of-the-way corners of the globe is such that, less than 100 years after Darwin first opened our eyes to the natural processes that over millions of years produced the complex biotic communities of the world's various continents, we are on the verge of utterly destroying many of them. Although we have made a start on classifying and naming the species of plants and animals that form the cogs in these complex assemblages, we still know little of the real role of each species in the life of its community, nor have we even scratched the surface in understanding the natural laws that produced and regulate these wonderfully stable, climate-dominated, land-occupying superorganisms.

RICHARD H. POUGH.

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# LETTERS

## Père David's Deer and the European Bison

In response to our recent article entitled "The Story of the Milu," the following informative letter has been received from the Duke of Bedford:

SIRS:

I have read with great interest the article on Père David's Deer in the October number of NATURAL HISTORY.

By the discovery of a good many sub-fossil remains, it is, I think, now definitely established that the original wild habitat of this animal was in the Honan district of China and the middle reaches of the Yellow River. The antlers appear, in some cases, to have been used as primitive implements by the human inhabitants of the period, just as in Europe Red Deer antlers were used for a similar purpose.

I was glad to hear recently that the four young Père David's Deer reached Australia safely.

Your article also refers to the European bison, and I might say that by far the largest surviving remnant of this animal exists in Poland, where I believe, there are 90 animals. There are also a few in Sweden, a few in Germany, and one or two in various continental zoological gardens. The Woburn herd at present numbers fifteen, and I hope to obtain shortly a new bull from Poland.

I always feel a little sorry that the United States, with its great facilities for success in this direction, is not doing much to preserve, on its own territory, the many fine species of deer and other animals from abroad that are at present being threatened with extinction in their native habitat. Although admirable work is being done for the preservation of rare American species, foreign species seem to be neglected, partly as a result of lack of interest on the part of those who might undertake the work, and partly because of the extremely unhelpful attitude of the authorities. Like their counterparts in some other countries, they suffer from a most exaggerated complex with regard to the danger of introducing cattle disease by the importation of foreign ruminants. With reasonable quarantine precautions, there is not the slightest danger from this

**NOTICE**—Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on these pages will be paid for at \$3.00 each, with full credit to the photographer. Return postage must be included.



Photo by Josef Muench

▲ **MOUNTAIN SYMPHONY IN WHITE.** The open road beckons the motorist to study nature in her least known mood. The Grand Tetons in Wyoming

source. Indeed, most of the serious cattle diseases have such a short period of incubation that, even without any special rules with regard to quarantine, the conditions under which wild animals are usually imported, singly, in crates, themselves prevent infected specimens from reaching a new continent if they come by sea and not by air.

BEDFORD.

Woburn, Bletchley,  
Bucks, England.

## The Secret of Thalessa

SIRS:

I was interested in your article, "Drillers of the Insect World," in the October issue. You mentioned that the parasite locates the larvae of the horntail inside the wood of the tree by methods not yet explained. This past summer I had a good view of the parasite of the horntail in the process of laying its eggs in a tree by our house in Bucks County, Pa. It seems quite obvious to me that the parasite locates the horntail's larvae by means of its antennae. We watched this strange-looking insect carefully going over the bark of the tree with its "feelers." Once it had decided on a place, it went through extraordinary gymnastics, seizing its very long ovipositor with its two rear legs and drilling the hole. The insect practically stands on its head while laying its eggs, and the ovipositor makes a long, complicated loop. When it begins to pump the eggs, this loop becomes filled in with a thin membrane. The insects were busy

about this tree throughout August, and we even saw them flying around as late as September.

ALICE L. HOFF.

New York, N. Y.

It is possible that the parasite hears the larvae as they feed inside the wood.

—ED.

## The Christmas Star

It has become a tradition that during December visitors to the Hayden Planetarium will see time turned back nearly 2000 years and enjoy the skies as they shone near the time of the first Christmas. Several interesting theories about the Bethlehem Star will be discussed and illustrated. The program this year promises to be more elaborate and exciting than ever before.

## Tiger Beetles, Silver-striped Scarabs, and Fighting Scorpions

Expeditions during the summer and fall have raised the American Museum's insect collections to a total of more than 2,700,000 specimens, it was recently announced by Dr. Mont A. Cazier, Chairman of the Department of Insects and Spiders.

One element in the recent increase was what has been called the finest single collection of Tiger Beetles ever secured—7000 specimens collected by Dr. and Mrs. Charles Vaurie during a 12,000-mile trip. The Tiger Beetle ranks among the most wary insects and shows remarkable resourcefulness in eluding the collector. The collection includes 99 of the unusual

White Tiger Beetles, which will furnish valuable information on the evolution of these insects.

Dr. Willis J. Gertsch, who concentrated on the Rockies and western deserts, collected 20,000 specimens, including more than 4000 spiders and scorpions. He secured several specimens of a scorpion rarely taken in this country—the rare “Wind Scorpion,” popular among the Arabs as a “prize fighter.” It is only about one inch long but has very large jaws. Dr. Gertsch also brought back a number of primitive six-eyed spiders, or “weaver spiders,” whose cocoons, woven from leaves, have rarely been collected for scientific study, though they are fairly common in the Arizona desert. Most beautiful among his treasures, however, is the very rare light green scarab beetle, *Plusiotus gloriosa*, which wears a series of bright silver stripes. It is known as one of the most handsome insects. The importance of photographic work on field trips of this nature is indicated by the fact that Dr. Gertsch alone took more than 1700 pictures.

Another collection of several thousand Tiger Beetles was gathered in western Mexico by Mr. and Mrs. George Bradt, of Tucson, Arizona, bringing the Museum's total collection of Tiger Beetles to about 80,000.

#### Edwin Way Teale's Photographs

About 60 selected photographs by the author of *Grassroot Jungles* and other outstanding books will be displayed through January 3 at the American Museum, in a special exhibit entitled “Insect World.” In addition to his prominence as a nature writer, Mr. Teale is an Associate of the Royal Photographic Society in London, and a number of his photographs are now on exhibition there.

#### Ancient Ghost City Found in Afghanistan

A “lost city” covering an area of about five by six miles and showing every indication of having been abandoned suddenly many, many centuries ago has recently been discovered by an American Museum expedition exploring an inaccessible section of Afghanistan.

This most extraordinary ghost city is estimated to have had perhaps as many as 100,000 inhabitants. Household articles such as cooking utensils and furniture were found just as would be expected if the population were suddenly forced to leave. Houses, fountains, aqueducts, and

irrigation ditches remained almost intact. Even the ancient fort stands in defiant but silent defense of the empty desert metropolis. Preliminary estimates indicate that the city flourished around the time of the Crusades.

The expedition, under the leadership of Walter A. Fairservis, was crossing the fabled Dashti-Margo, or “Desert of Death,” in the southwestern section of Afghanistan when the remarkable discovery was made. Accompanying Mr. Fairservis on the 6000-mile journey by jeep and trailer were Louis Dupree, graduate student in archaeology at Harvard University, and Henry W. Hart, an architect and graduate student of Yale University.

Though it seems strange that such a conspicuous landmark had not previously been reported, it is to be remembered that this is one of the least known parts of the world. The area is practically unknown even to the Afghan people.

According to native legend, the city was probably abandoned when an invad-

ing force cut off the water sources, rendering survival impossible. However, Mr. Fairservis points out that the wells of the ghost city are completely dried up, and he is more inclined to attribute the evacuation of the city to a sudden climatic change. Further study in this area may thus support the theory held by some scientists that basic migrations, sometimes affecting large geographic areas, are often caused by climatic change. It is thought by certain Afghan scholars that this is the once great city of Peshawarun, often mentioned in legends, and that its residents trekked some 700 miles over deserts and mountains to become the founders of the modern city of Peshawar on the north-west frontier of India.

It is hoped that an article will soon be published in *NATURAL HISTORY* giving a full account of the discovery. Mr. Fairservis hopes to return to the area next summer with a complete staff of archaeologists to begin more intensive examination and study.

## Remember the Sugar Pines

Readers will recall that *NATURAL HISTORY* Magazine carried information about the danger threatening the Sugar Pines of Beaver Creek Valley, in the February, April, May, and November issues of last year.

In a beautiful section of California, this tract, which is less than three miles long, contains the world's finest remaining examples of the Sugar Pine. Some of the trees are 8 feet or more in diameter and from 200 to 240 feet tall. Without the intercession of strong public opinion, this forest will be cut for commercial use.

To keep our readers up to date on this situation and to urge every possible action for the defense of these trees, we publish the following communication recently received from John B. Elliott, President of the California War Memorial Park Association:

#### Does Public Opinion Really Count?

One answer to that question is the long, hard fight of the California War Memorial Park Association, Inc., to preserve the magnificent Sugar Pines and giant Sequoias of Tuolumne County in California as a War Memorial Park.

This Association, composed of the leading citizens of California, has been fighting for this project for almost two years. Endorsements of their endeavors include every state veteran's organization, both A.F. of L. and C.I.O., and hundreds of other leading state-wide organizations. The total membership of the organization endorsing this worthy project is more than 2,500,000 persons.

On the other hand, the project is opposed only by a lumber company and its

henchmen. Yet, after almost two years one wonders if the California War Memorial Park Association is really any nearer the goal they set out to achieve.

How a lumber company that was assisted by a government R.F.C. loan when it was at its lowest ebb can ignore the wishes of 2,500,000 people is not understandable. Nevertheless, that is what is taking place. This lumber company has resorted to every conceivable means to “submarine” the genuine and sincere efforts of these California citizens.

The California Congressional delegation recommended to Secretary of Agriculture Brannan last March that he take over the area. The Governor of California has committed the State for \$500,000, or if necessary a larger amount, to purchase the area from the Federal Government after the Secretary of Agriculture has taken possession from the private owners. Yet this lumber company, the project's only real opposition, has been able, through the U. S. Forest Service, to delay, confuse, and further delay the Congressional recommendation.

If the lumber company were to lose in the end, one might understand its reason for some resistance to the plan. But under the Statute of 1909, the company will receive other Federal-owned timber in exchange for this unique area. The lumber company cannot lose.

The decision rests entirely with Secretary of Agriculture Brannan, and if public opinion really counts, the California War Memorial Park Association will win its long fight.

The question, however, remains unanswered, and one wonders.

Does public opinion really count?

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VOLUME LVIII—No. 10

DECEMBER, 1949

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to Periodical Literature* in your library



THE COVER THIS MONTH

Cactus flowers are among the most beautifully textured creations of nature. Coming in all colors except blue, they shine like fine silk and satin. Many last only for a single night, while some remain open for three or four days. Among the chief beauties are the species of *Echinocereus*, commonly called hedgehog cactus, whose flowers run the entire range of cactus colors. They are native from Oklahoma and Wyoming to California and as far south as Mexico City. *Echinocereus polyacanthus*, depicted here, has a wide occurrence in the southwestern United States and adjacent Mexico. The plants grow in clumps of several spiny-armed stems up to one or two feet tall and two to four inches in diameter. The bright red flowers remain open day and night for about four days and in due time are followed by spiny red fruits. These look like giant strawberries and are responsible for the common name, strawberry cactus. The spines are easily removed, and the fruits, when cooled in the refrigerator and eaten with cream and sugar, have a delicious flavor.

E. J. ALEXANDER.

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EDITOR: Edward M. Weyer, Jr.  
Elizabeth Downes, *Editorial Assistant*.  
Atherlie K. Gidding, *Editorial Assistant*.

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# YOUR NEW BOOKS

## American Spiders • Indians • Max Planck Skyshooting • Pageant of Life Science

### AMERICAN SPIDERS

----- by Willis J. Gertsch

D. Van Nostrand Co., \$6.95  
272 pp., 111 photos,  
44 in full color

FOR generations, an attitude of unthinking anthropomorphism has attributed "cruelty" and "deceit" and "evil" to the spider. Popular prejudice verges on a phobia. It is to be hoped that Dr. Gertsch's informative and superbly illustrated book will lead readers to examine from a fresh viewpoint the value and interest inherent in spider life.

*American Spiders* is the second volume in the New Illustrated Naturalist series, begun under the editorship of the late Dr. Clyde Fisher. It is also the substantial by-product of more than two decades of field and laboratory research by one of the world's leading spider biologists. Dr. Gertsch's book covers the evolution of spiders, their relation to other arthropods, their life cycle and structure, their medical and economic importance. It tells of the love dance of the males, the ballooning of the spiderlings, the bizarre mating habits of one species in which the female is half an inch long and the male the size of a pinhead. It stresses the importance of spider silk—able to stretch a fifth its length without breaking, second only to fused quartz in tensile strength, yet so delicate it is sometimes produced in threads only one-millionth of an inch thick. It deals with such diverse spiders as the orb weavers, the fishers, the tarantulas, the blind spiders of Mammoth Cave, and the bola spiders that use a thread weighted at the end with a drop of liquid silk to capture their prey in the manner of a Gaucho using a bola.

The full-color plates and dramatic action shots, such as Walker Van Riper's speed picture of a jumping spider in mid-air with its dragline playing out behind it, are, in themselves, real contributions to spider study. Well-printed, well-illustrated, and carefully written, Dr. Gertsch's

book is, and is likely to remain for years to come, *the* book on the natural history of North American spiders.

EDWIN WAY TEALE

### THE AWAKENING VALLEY

----- by John Collier, Jr., and  
Anibal Buitron

University of Chicago Press, \$6.00  
199 pp., 167 illuts.

SUCH census figures as are available indicate that there are roughly seven million Indians living in the Andean areas of Colombia, Ecuador, Peru, and Bolivia. Because of the nature of this terrain, many exist only by a subsistence agriculture involving prodigious physical effort. The tangible rewards are so slight that the natives by necessity must adhere closely to a pattern of life fixed centuries before the Spanish conquest. Although many popular articles have been written about this region, few serious anthropological studies are available, with the result that most of us have only a hazy concept of what life there actually involves. The present splendid volume, planned for popular use but of great value to anthropologists, will do much to dispel this ignorance. I hope it will be widely distributed and used.

Its theme is the story of the people of one valley in Ecuador, a people who, in spite of what to us would be abject poverty, are evolving a vigorous economy of their own. This without any governmental or other outside assistance. The remarkable and thrilling aspect is that these people are typical Andean Indians and that what they are accomplishing could so easily be achieved elsewhere in the region.

The story is simply told with 167 remarkably beautiful and well-chosen photographs and with 60 pages of text in addition to captions. It is an extremely honest and unemotional appraisal covering virtually every phase of life. Congratulations to the authors and to those who made its publication possible.

JUNIOUS BIRD

### INDIANS OF THE URBAN NORTHWEST

- Edited by Marian W. Smith

Columbia University Press, \$6.00  
370 pp., 12 pls., 16 figs.

THE term "urban northwest" refers to that great metropolitan area stretching from Vancouver, British Columbia, to Olympia, Washington. Before the coming of the white man, this region formed a portion of the traditional territory of the Coast Salish Indians who, surprisingly enough, have adjusted better than most tribes to twentieth century life.

The present book is a compilation of fourteen papers dealing with the Coast Salish from several distinct points of view. It is not intended to serve as a definitive work on these tribes; rather, as the editor states, "—this book was written for people who already know something about the Pacific Northwest and who want to know more." Yet, in spite of omissions and an essential lack of unity, the book manages to characterize the essentials of Coast Salish culture in a way seldom achieved in the conventional ethnological monograph.

In addition, this book will give the layman an idea of some of the principal approaches devised by anthropologists for the study of mankind in general. Thus selections included fall within such generally recognized branches of anthropology as ethnology, archaeology, physical anthropology, and linguistics. Newer interests of anthropology are also represented by chapters dealing with child behavior, diet, and an excellent autobiography of a Coast Salish medicine man.

The adaptation of the Indian to present-day culture is stressed throughout. Before the coming of the Whites, the Coast Salish was astute in his business dealings and accustomed to economic specialization. Although industrious, he was fond of comfort; and to him cleanliness

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## AMERICAN SPIDERS

by Willis J. Gertsch

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250 Fourth Avenue, New York 3

ness (even in economics) was next to godliness. These traditional values clearly stood him in good stead in his adjustment to modern American civilization.

HARRY TSCHOPIK, JR.

## NORTH AMERICAN WATERFOWL

----- by Albert M. Day

Stackpole and Heck, Inc., \$4.75  
329 pp., 59 illu., and maps

HERE, in one volume, is the story of a continent's waterfowl—their once fabulous abundance, the merciless hunting to which they were subjected, their decline, and finally the modern era of protection, refuges, and closely regulated hunting. Its author, the present Director of the U. S. Fish and Wildlife Service, joined that organization some 30 years ago, at about the time when it was first charged with responsibility for safeguarding waterfowl.

He details the history of protective legislation, starting with the largely ineffective state laws and culminating in the migratory bird treaties that we are still in the process of negotiating with our Western Hemisphere neighbors. The bulk of the book is devoted to a full explanation of the vast machinery that has evolved in the past fifteen years for restoring and maintaining waterfowl

breeding and wintering grounds, checking on their populations, and regulating the hunting seasons.

Few duck hunters and still fewer ordinary citizens realize how much time and effort go into the job of setting each year's hunting dates and bag limits so that they will safeguard the breeding population and yet permit a reasonable harvest of the animal crop. A reading of this book should have a salutary effect on those self-constituted experts who always insist that there are plenty of ducks and that they know more about the matter than a lot of "Washington bureaucrats." With the results from the banding of thousands of ducks, the running of countless breeding marsh transects both on the ground and from the air, careful winter counts, and many other sources of precise information, the Fish and Wildlife Service knows just about how many ducks they can safely permit the continent's hunters to harvest each fall. Especially interesting to many will be Mr. Day's explanation of the factors that led to the division of the continent into four flyway zones, each with its own specific seasons and bag limits.

The most outstanding areas in the vast waterfowl refuge system set up by the state and Federal governments are described and their importance indicated. It is interesting to learn to what a considerable degree most of them have been improved as waterfowl habitats by the expert management of the Service's biologists and engineers. The author also stresses the important role that the states have played in recent years, using funds made available to them by the Pittman-Robertson Federal Aid program. The figures show that some 22% of these funds have gone into waterfowl work since the program's inception.

The final chapter, "Your Waterfowl," concludes with a plea for better law observance and should be read by every American who hunts or fishes.

RICHARD H. POUCH.

## TWILIGHT IN INDIA

----- by Gervée Baronte

New York Philosophical Library, \$3.75  
382 pp., 11 plates

THE publisher informs us that the author of this book "has lived many years in India," that she "treats mainly of Hinduism, the most hopeless conglomeration of superstitions since the world began," and that she "aims at exposing the insanity and the filth that is corrupting two-thirds of India's population."

Not even the most ardent admirer of Indian civilization will deny that it has more than its fair share of dark spots. However, there is a difference between unbiased, understanding criticism and the placing of one-sided emphasis on the

less savory traits of a people and their civilization, thereby producing a picture that is completely out of focus. The author seems to have taken particular delight in ferreting out all that is objectionable (or what to her seems objectionable) in Hindu life and religion. She rarely misses an opportunity of inserting some unnecessary critical remarks. Her naive statements and interpretations show that she lacks the anthropological and historical background that might have given her a better understanding of her subject. Since she rarely mentions her sources, it is often not clear what she has read, what she has seen herself, and what she heard from her friends. Most of the chapters on castes and hill tribes seem to be condensed from Thurston's *Castes and Tribes of Southern India* and similar works. A few of the author's own observations would be of some interest, could we only be sure that they are correctly reported. However, the numerous unwarranted generalizations, inaccuracies, and outright misstatements contained in the book cannot fail to arouse our suspicion. The case of the frontispiece is typical. It shows an image of Gangā, the goddess of the river Ganges, as pronouncedly female as only an Indian goddess can be. Yet, the label assures us that this is "the god" of the Ganges.

ROBERT HEINE-GELDERN.

## THE LOST PATHFINDER—ZEBULON MONTGOMERY PIKE

----- by W. Eugene Hollon

University of Oklahoma Press, \$3.75  
240 pp., 12 illu.

BECAUSE of the mountain itself and the famous slogan, "Pike's Peak or Bust," the adventures of Zebulon Montgomery Pike are of interest to most of us.

In *The Lost Pathfinder* Mr. Hollon has a good story to tell, although he is too much the professional historian to indulge in much speculation or embroidery of fact. The first part of the book is a bit dull, because too much background material is crammed within too little space.

Pike's first expedition, 1805-1806, was as disappointing in accomplishment as it is to read about. He completely failed in his three objectives but returned feeling complacent about his achievements. In 1806-1807, he led the first American expedition across the Great Plains and into the Rockies to find the headwaters of the Arkansas River. The hardships his party encountered are almost unbelievable, and

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the fact that Pike saw his mountain by accident, and never did reach its summit, seems somewhat pathetic.

It still is not known, despite Mr. Holton's meticulous search, what the actual purpose of the trip was, or why Pike behaved as he did when he invited capture by Spanish troops above Santa Fé. His subsequent travels through Mexico and his return to the United States to find himself an object of suspicion over the Wilkinson-Burr conspiracy provide interesting reading. After several years of trying to advance himself in the army, Pike was killed, a general at the age of 34, during the York campaign of 1813.

Through the maze of facts, dates, and footnotes in this book, there gradually emerges the picture of Zebulon Montgomery Pike. He was a good soldier, brave with the courage of ignorance, blindly loyal to his friends, egotistical, and quite without humor.

Many readers may feel a slight irritation that such a man should have so great a monument.

MARTHA R. BOGERT

## SCIENTIFIC AUTOBIOGRAPHY AND OTHER PAPERS

----- by Max Planck

Philosophical Library, \$3.75  
192 pp.

IT is idle to argue whether Einstein or Planck was a greater physicist. Both have profoundly altered our concepts of the physical world. Planck's quantum theory was such a radical departure from previous theories of radiation and other forms of energy emission that it seems interesting to know how it was ever discovered. This, Planck tells us step by step in his very informative autobiography. His epoch-making theory was conceived and published in 1900 when he was 42 years old, 21 years after he had earned his doctor's degree. It was the last step of a long chain of studies and considerations rather than a sudden flash of genius, as are so many discoveries of young physicists.

The other four essays of this attractive little book deal with subjects that are best described by their titles: "Phantom Problems in Science," "The Meaning and Limits of Exact Science," "The Concept of Causality in Physics," and "Religion and Natural Science." I found the discussion on causality particularly stimulating, a subject of very acute interest to physicists

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ever since the establishment of the Uncertainty Principle by Heisenberg, Planck shows that there is a conflict between those who consider causality as absolute and those who consider it merely a statistical phenomenon. This conflict can be ideally resolved (though never practically!) by recognizing the observer as the chief variable. As an organizing principle, the law of causality has lost nothing of its usefulness. In the final essay Planck states his belief that religion and natural science are allies in a battle against scepticism, dogmatism, and superstition.

Every reader of these essays by one of the great thinkers of our time will be greatly stimulated, whether he agrees with all of his conclusions or not.

E. MAYR

## TRODDEN GLORY

The story of the California Poppy, with a description of some Russians

----- by Cameron Rogers

Wallace Heberd, Santa Barbara, Calif.  
130 pp., 3 illust.

THIS book is mainly a history, vividly told, of the American west coast between California and Alaska, at the height of the Russian trading era between the years 1790 and 1835. Woven into the account are stories of the lives of the three eminent botanists, Menzies, Von Chamisso, and Douglas. The California poppy, which all three shared in making known, opens its flame-colored petals here and there through the chapters and serves as the tenuous thread on which this somewhat rambling book is strung.

One chapter each is given over to the two Scots: to Menzies, in honor of whom the plant *Menziesia* was named; and to Douglas, of Douglas fir fame. The body of the book is concerned with von Chamisso and many colorful and sometimes violent characters—particularly the Russians, Romanzof, Shelikof, Baranof, and Kotzebue. Side lights are thrown on a variety of matters related to those early colonizers of western America, including the near-extirmination of the sea otter; the slaughter of the fur seals and walrus; the behavior of the Kolosh and other tribes of Indians; the early missionaries—particularly Father Juvenal; and the development of the Russian colony at Bodega, 18 miles north of San Francisco. We are introduced to Chloris, painter and craftsman, and to Eschscholtz, after whom von Chamisso named the California poppy, *Eschscholtzia californica*. Incidentally, the author pokes fun and a little scorn at the technical description of that plant.

Mr. Rogers' style of writing is vivid and rich in allusion. At times he is frankly discursive, having to snatch himself back after a page or two to his main exposition of the moment. For a few lines he may be laconic, or even adopt a clipped, al-



THIS is the master work of Herbert P. Whitlock, former Curator of the Morgan Gem collection. "Its 10 chapters and 179 plates, six in color, tell the story of jade for the reader who would like to know something of jade as a mineral, how it was so skillfully worked, and what the craftsman-artists who fashioned the innumerable objects from various kinds of jade intended their work to mean.

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most telegraphic way of writing. Clearly he has immersed himself deeply in his subjects.

The book, which would be helped for some by the addition of an index, is illustrated by photographs, seemingly made of drawings or paintings of Menzies, Eschscholtz, and Douglas.

G. H. H. TATE.

## PAGEANT OF LIFE SCIENCE

----- by M. W. de Laubenfels

Prentice Hall, Inc., \$5.95  
407 pp., 1024 illusts.

IN this encyclopedic quarto-sized documented volume of 407 pages, illustrated with black-and-white drawings and halftones, the author, an authority on the sponges, tries—reasonably successfully—at an elementary level to cover the entire gamut of the biological sciences. The book, in the present edition, is divided into five major heads: general, human, plant, animal, and social biology. Each major division in turn is split into half a dozen subheads. The arrangement, therefore, is somewhat changed from the earlier edition of 1941. There are new sections in the botanical portion of the work, including a good disquisition on soil conservation by contour plowing.

It is possible to touch upon no more

Continued on page 476



◀ Mt. McKinley at a distance of 25 miles, photographed from Wonder Lake, the stamping ground of the three prospectors who first ascended the mountain. The climbers chose the North Peak, probably because from this point the South Peak is hidden

# The Incredible Conquest of MT. MCKINLEY

You think it takes thousands of dollars and years of training to climb high mountains. But a barroom challenge led to the first ascent of the highest mountain in North America—a polar expedition in three dimensions, by amateurs

By LOUIS R. HUBER

Photographs by BRADFORD WASHBURN

BILLY McPHEE, rotund Fairbanks saloonkeeper, brought his fist down on the mahogany bar, causing the glassware to jingle.

"I got five hundred dollars in gold dust in that till over there. Every grain of it says Alaskans are gonna be first to reach the top of Mt. McKinley. If that ain't enough for an outfit an' some grub, I got more. Now, who'll climb the mountain?"

This was the prologue, early in 1910, to the first successful ascent of North America's highest mountain. Six sourdoughs took up McPhee's challenge; two of them got to the top of the mountain, and a third almost made it. Though they were strictly novices in mountaineering, no one has ever equaled

them for sheer guts and hardiness. They "took it easy" up to 11,000 feet. There they proceeded to build a 4000-foot stairway and then surged right on to the top. When they got back, nobody would believe them, until . . . but we mustn't get ahead of the story.

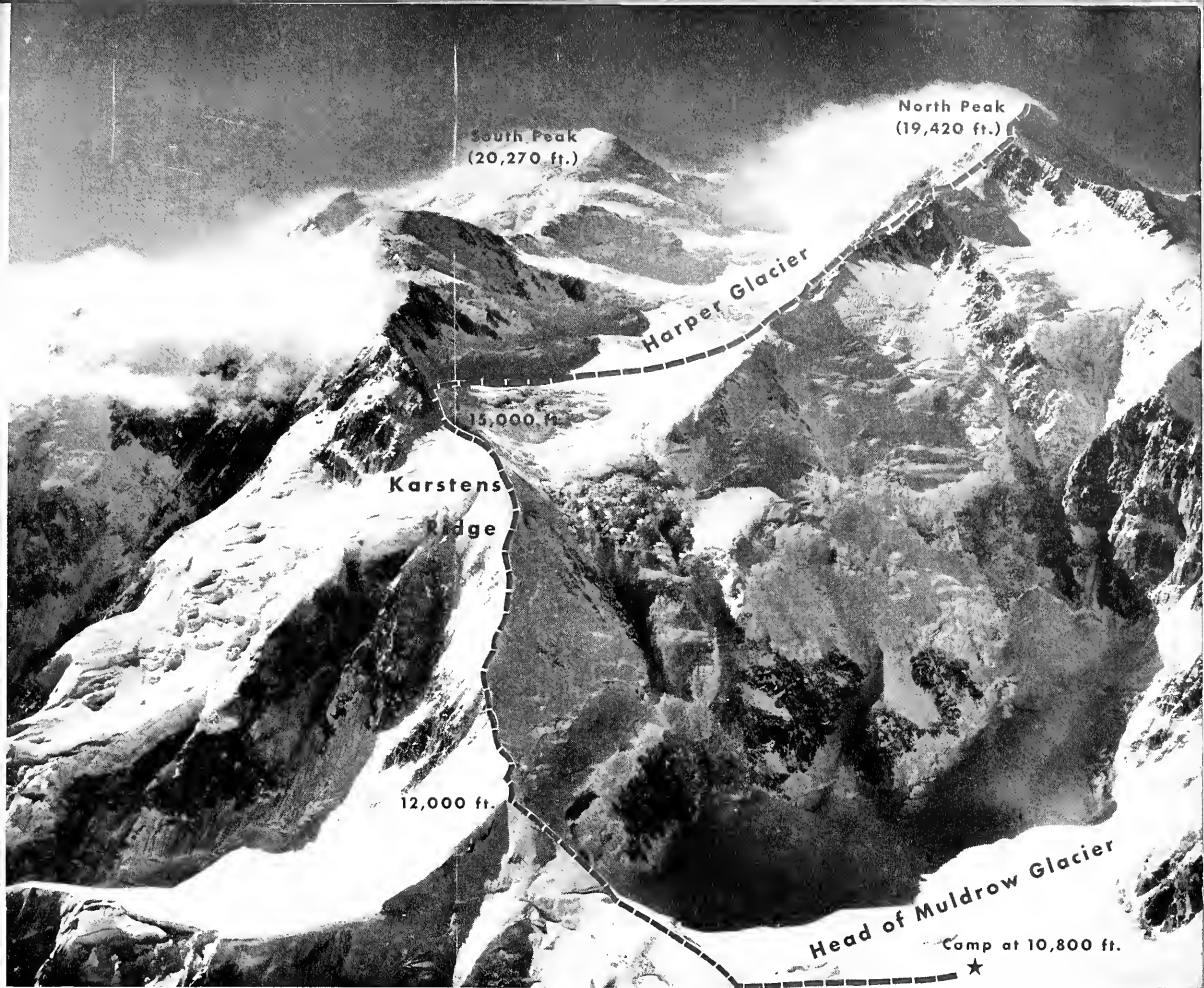
The history of our highest mountain is as short as its peak is high. In 1889 Frank Densmore, a prospector, went into the Cook Inlet country of Alaska. He came back without much gold, but he had an amazing tale about a high mountain, which soon became known in the Yukon Valley as "Densmore's Peak." His fellow gold seekers didn't know the Indians had called this mountain "Denali" for ages

▼ HUGE CREVASSES like this, often completely hidden by treacherous, flimsy snow, are the greatest danger encountered in this icy world, except for the sudden storms that occur high on McKinley's slopes



nor that the Russians, occupying Alaska until 1867, had called it "Bolsheia"—both terms meaning "The Great One." In 1896 a second prospector, W. A. Dickey, wandered past and named the peak all over again. Obviously a staunch Republican, he called it "Mt. McKinley," in honor of the presidential candidate. This name stuck, much to the chagrin of apostles of aboriginal nomenclature. They insisted that "Denali" was the rightful name—just as they maintain that "Tacoma" is correct for 14,408-foot Mt. Rainier, near Seattle.

At this time nobody had much idea how high Mt. McKinley was. In 1897, the Duke of the Abruzzi came over from Italy with a large



▲ AN AERIAL VIEW of Mt. McKinley taken from an altitude of 15,000 feet, showing the exact route followed by the prospectors in 1910

### History of Mt. McKinley

(Originally called Denali by the Indians)

- |   |  |
|---|--|
| <p>1889 Frank Densmore reported and described the mountain, and it came to be called Densmore's Mountain.</p> <p>1896 W. A. Dickey named it Mt. McKinley after the Republican presidential candidate.</p> <p>1897 The Duke of Abruzzi climbed 18,008-foot Mt. St. Elias, 375 miles to the southeast, thinking it to be the highest peak in North America.</p> <p>1900 The U. S. Geological Survey measured Mt. McKinley (20,270 ft.).</p> <p>1903 First attempt to climb Mt. McKinley made by Judge Wickersham of Fairbanks.</p> <p>1903 Second attempt (from the northwest) made by Dr. Frederick A. Cook.</p> <p>1906 Dr. Frederick A. Cook claimed to have climbed it (from the southeast).</p> <p>1910 The sourdoughs made their famous ascent of the North Peak.</p> | <p>1910 The Parker-Browne expedition assaulted the south face of the South Peak unsuccessfully.</p> <p>1912 The Parker-Browne expedition reached a point only 150 feet below the summit of the South Peak but were driven back by a tremendous storm.</p> <p>1913 Archdeacon Stuck's party (four men) made the first ascent of the South Peak, on June 6.</p> <p>1932 South Peak ascended by Lindley-Leik expedition (four men).</p> <p>1932 North Peak ascended by Lindley-Leik expedition (four men).</p> <p>1942 South Peak ascended in July by U. S. Army Alaskan Test Expedition (seven men).</p> <p>1947 South Peak ascended in June by Boston Museum of Science expedition (eight persons; first ascent by a woman, Barbara Washburn).</p> <p>1947 North Peak ascended in June by Boston Museum of Science expedition (six men; first ascent by a woman).</p> <p>1947 South Peak ascended in July by three University of Alaska students.</p> <p>1948 South Peak ascended in July by three University of Alaska students.</p> |
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retinue of Alpine guides and porters and climbed 18,008-foot Mount St. Elias on the coast, never dreaming that a mountain more than 2000 feet higher lay 375 miles to the northwest. About 1900, the United States Geological Survey came along and measured Mt. McKinley—and the race was on. Here, indeed, was the highest point in North America. But that was not all: McKinley was the highest mountain mass in the world rising out of a lowland plain; 14,500 feet of it is in a single precipice, while the highest cliff on Mt. Everest is about 9000 feet.

The sky-sweeping heights of the Himalayas and the Andes are higher than McKinley (29,000 and 22,800 compared with 20,270 feet) but those mountains rise from lofty plateaus that are 10,000 to 15,000 feet high. Mt. McKinley sits on a tableland that is only 2000 feet above sea level. It soars up to the sky in a gigantic, unbroken sweep—almost four miles of rock and ice from base to peak. Nowhere else on earth does a mountain rise in such majesty.

What a challenge to mountaineers,

who must here overcome not only height but arctic conditions as well! Mt. McKinley is probably the coldest mountain in the world. To scale it is a sort of polar expedition in three dimensions. Most of the world's high peaks are within 40 degrees of the equator, where snow and ice melt from their lower reaches. On 20,577-foot Chimborazo, in the equatorial Andes, which almost duplicates McKinley's height, firewood is found at 14,000 feet. Even in the 29,000-foot Himalayas, the level of perpetual snow lies at 17,000 feet. But Mt. McKinley lies only three degrees south of the Arctic Circle, and snow is always found on its lower levels.

The greater the perils, however, the greater the challenge—and as soon as McKinley's pre-eminence became known, mountaineers began arriving. Several parties failed over a period of years; then, in 1906, Dr. Frederick A. Cook claimed success. He wrote a book about it, *To the Top of the Continent*, and immediately was famous. He lost no time undertaking even greater adventures: Within three years he claimed he had reached the North Pole.

When in 1909 Admiral Robert E. Peary won lasting fame as the true discoverer of the North Pole, it became clear that Dr. Cook had been bamboozling the public. This was the news that aroused indignation in the sourdoughs and impelled them to try climbing Mt. McKinley themselves.

These would-be Alpinists, of course, didn't know the first thing about mountaineering. Prospectors shun mountains, as a rule: the higher they find gold, the more work it is to carry machinery up the mountain to mine it, and the harder it is to get the ore down. Snows force closure of high mines too early in the fall and keep them closed too far into the spring. But since they were going up Mt. McKinley for glory and not for gold, the sourdoughs' confidence was unbounded.

They set off lightheartedly. By



◀ AN IMPRESSIVE SCENE on the route followed by the sourdoughs. Here Muldrow Glacier flows through a gorge with a 3000-foot cliff on one side and a 5000-foot cliff on the other—almost as deep as the Grand Canyon. Dog teams and mountaineering equipment were not used by the sourdoughs; they carried only a shovel and left no pictorial record of their expedition



the time they came to the foot of the mountain, however, they disagreed over something and had a fist fight. Three of them stalked back to Fairbanks in a huff. The three that were left didn't have proper equipment—not even a rope, generally indispensable to any reputable mountaineer.

Not one of the sourdoughs could have told you that an *arête* is a ridge, a *coulir* a gully, or that *crampons* are climbing irons. So they just climbed on their nerves. Two things they did have: pluck and luck. Also they carried a fourteen-foot pole and an American flag, to be erected on the summit—they hoped. They had no particular idea which route to take; no climber except Dr. Cook had claimed he had found a feasible approach. The sourdoughs took a guess and began plodding their way up Muldrow Glacier—which later

proved to be the only practical route.

No one can say how long it took them to climb this icy roadway: they took no notes, and they never wrote a book. They just climbed. At length we find them at the head of the glacier, at 10,800 feet, where they paused to rest and to study the nearly vertical ice fields above them. Our adventurers were Pete Anderson, Billy Taylor, and Charlie McGonagall—rough, sturdy miners who didn't back down from a dare.

Having reached this height, the three men proceeded in their ignorance to flout another of the basic rules of mountaineering: they did not establish base camps at progressively higher levels, with shelters and food caches, to which, if blizzards should come, they could retreat for safety. They didn't have enough equipment to set up depots. Yet 9000 feet of the mountain had

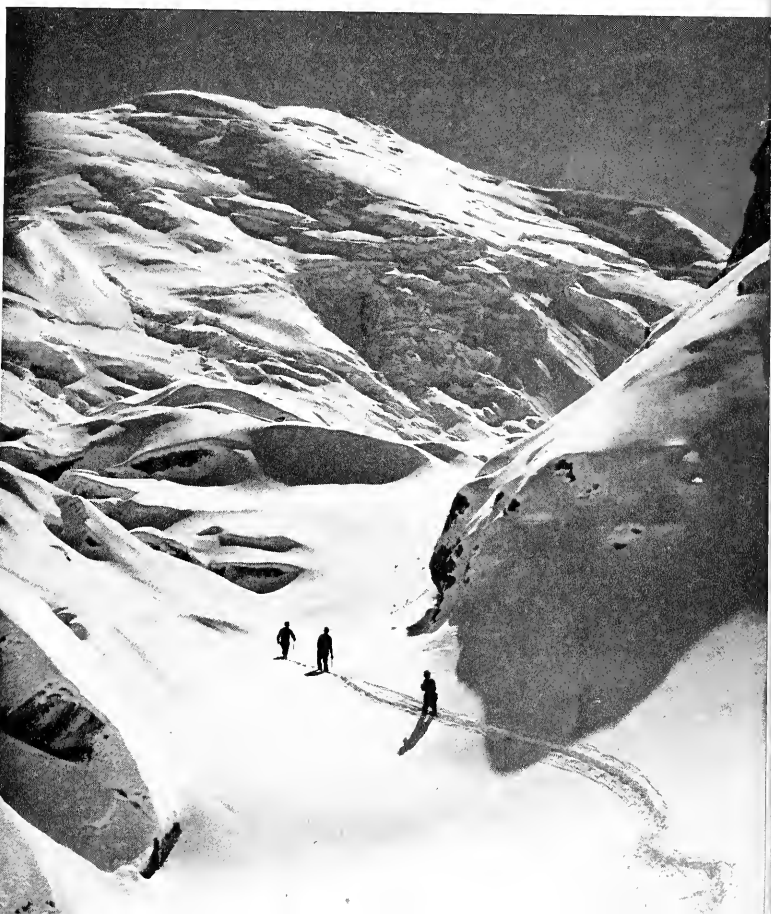
yet to be climbed. Their route was now obvious: up the great icy spine known today as Karstens Ridge. They investigated this ridge several times before attempting the final scramble. When blizzards closed in on them, they just waited and hoped their food would last. But when good weather allowed, they hacked and shoveled a staircase right up the 4000-foot ridge.

When dawn came clear on the morning of April 10, they had little more than a good-sized picnic lunch left. What of it—wasn't that enough for the rest of the trip? They started up, on the last 9000 feet of the mountain.

The ridge led them to a large snow basin later named Harper Glacier. At that point they had to make a choice—and here, for once, they went wrong. They could see the summit, and it consisted not of one, but of two peaks. One was the



▲ A MODERN PHOTOGRAPH taken near McGonagall Pass (5650 feet) and right on the sourdough trail up McKinley



► THE THREE PROSPECTORS in 1910 must have passed right near here, at an altitude of 6000 feet

south, or true, summit—20,270 feet high. The other was the north, or false, summit—19,420 feet high. From where they stood, the soursdoughs could not tell which peak was higher.

But the north peak was closer to Fairbanks; and it was the only peak that could be seen from Kantishna and Wonder Lake, only 25 miles away, where these prospectors and their partners had been looking for gold. They ardently hoped that a good spyglass down there would pick up the three tiny human specks inching their way toward the top. So they chose the north peak, and their vanity cost them undying fame. How were they to know that, among mountaineers, even a few inches at the top of a mountain can mean the difference between success and failure, glory and oblivion? At any rate, up they went.

When they had climbed to 19,000 feet, McGonagall had had enough. He had hauled the heavy flagpole all the way up to that point, and the icy wind whipping around the ridge had numbed him. He had a headache from lack of

oxygen; he was plumb tuckered out.

"Go on up," he told the others. "I'll wait for you down at the snow basin." Today McGonagall is the only one of the three remaining alive. He is still an active man and can be seen hard at work outdoors around Fairbanks.

Anderson and Taylor struggled up the fearful slope. The sun grew just warm enough to keep the frigid wind from freezing them. They didn't stop until they reached the top.

Anderson tied the flag to the pole they still carried, while Taylor hacked a hole in the ice. Then they planted the butt end of the pole in the hole and stomped ice and drifted snow into a pyramid around it. This done, they took a good look at the incomparable view stretching off around them in all directions for hundreds of miles.

The nearest and most impressive sight was, of course, the snow cone of the south peak, two miles away across the deep valley of Harper

Glacier. Second most impressive was the incredible plunge, right at their feet, down the 14,500-foot snow and ice wall of the north face to Peter's Glacier. Beautiful Foraker ("Denali's Wife" to the Indians) towered twelve miles away to the west, floating like a silvery island in a sea of clouds. Far to the southwest lay the broad valley of the Chulitna River, favorite dogteam route of prospectors mushing from Cook Inlet to the interior. To the north and west lay the broad, flat plain where the Kuskokwim River has its source.

They looked especially hard to the northeast—toward Fairbanks, 160 miles away. And toward Kantishna and Wonder Lake they waved their arms in salute to their partners, even though their gestures would not have been visible through the telescopes available in that day.

Then they started down.

They overtook McGonagall and covered the full 9000 feet they had climbed that day, down to the head

▼ FROM THE CAMPSITE marked on this photograph at 10,800 feet, the soursdoughs planned their final assault on the world's coldest mountain. The South Peak is seen at left, the North Peak at right





▲ KARSTENS RIDGE, the wind-swept knife edge of snow up which the prospectors cut a 4000-foot stairway toward success. But convincing the world of their achievement proved more difficult than the ascent itself

of Muldrow Glacier. In less than 24 hours they had, without even realizing it, surpassed all records for a day's climb at such high altitude.

Exceptionally good weather had made their feat possible; to that they owed not only success but, undoubtedly, their lives as well. Experienced mountaineers still exclaim over the sourdoughs' accomplishment with amazement and respect.

The three climbers returned to Fairbanks and told the patrons of Billy McPhee's saloon—drinks on the house—all about their trip. They told about it again and again—and there was one question people always asked, in the end:

"Did you *really* get to the top?"

Anderson, Taylor, and McGonagall got very tired of it. When they realized that even their friends didn't really believe that they had



▲ THIS LONELY SCENE must have been exactly re-enacted in 1910. Just above here, the sourdoughs tackled the great 3000-foot ice and snow gully that leads to the North Peak (behind camera)

upheld Alaska's honor after all, they were bitter.

"Hell, yes, we got to the top," they would answer, when the inevitable question came. "We got there, all right—and if you don't believe it, climb up and take a look. We stuck a flagpole in the top of it."

The assault upon Mt. McKinley continued; indeed, even as the

sourdoughs were reaching the top, there was another expedition on the other side of the peak, searching in the wrong place for a route upward. It never got above 10,000 feet, about halfway. In 1912 this same expedition returned and, following the route of the sourdoughs, got to within a few hundred feet of the top when a blizzard drove them back.



▲ THE CLIMBERS CIRCLED this steep slope at about 14,600 feet to reach the first plateau of Harper Glacier. South Peak, more than 5000 feet higher, is seen in the center

In 1913, two Alaskans led an expedition that succeeded at last in reaching the summit of the south—and highest—peak. They were the Reverend Hudson Stuck, a mountaineer of experience and Episcopal archdeacon of the Yukon Valley; and Harry Karstens, a sturdy sourdough. With them were R. G. Tatum, another sourdough; Walter Harper, a robust half-breed Alaskan Indian; and Johnny Brown, an Indian from Stuck's Nenana mission, who tended the dogs at the base camp. This expedition had a terrible time climbing most of Muldrow Glacier and Karstens Ridge. This route had been relatively easy three years before, but the great earthquake of 1912—as though to immortalize the glory of the sourdoughs—had disrupted it fantastically. Archdeacon Stuck's party climbed under the greatest technical difficulties ever experi-

enced by any group before or since. But all the way, as might be expected, they took occasion to discuss the question of whether the sourdoughs had really reached the top.

It was probably Walter Harper whose sharp eyes first saw the pole.

"There it is!" he cried. "It's still standing there!"

Out came binoculars, and they scanned the peak. Sure enough, there was the pole! Wind had long since shredded and scattered the American flag; but the fourteen-foot pole was still erect, sharp against the blue—"plain, prominent, and unmistakable," Stuck later wrote.

The sourdoughs had really got to the top, even if it had been the false summit, 300 feet short of the goal.

The Stuck-Karstens climbers continued to have good weather and reached the south peak; and Alaskans thus were victorious in the

long struggle to set foot on the top of the continent. Since then a number of climbers have conquered the mountain, but it has also taken its toll in human life. Greatest dangers, perhaps, are the deep crevasses in the glaciers, hidden under a treacherous covering of snow. It was one of these crevasses that cost the lives of Allen Carpe and Theodore Koven in 1932. The National Park Service, in whose domain the mighty mountain lies, does not want to have to rescue foolish adventurers from its hostile slopes. Only well-equipped and capable expeditions will be given permission to explore the dangerous sections.

Even with the best modern equipment, McKinley is no cinch. The sourdoughs of 1910 did it the hard way. On their side was their knowledge of snow and ice and of sub-zero camping—indispensable assets. But the feat was physically tremendous, and there were a multitude of hidden and unpredictable dangers. We must always admire them for their audacity, determination, and sheer grit.

▼ THE VIEW SEEN BY THE VICTORIOUS PROSPECTORS from the summit of North Peak, looking northeast down the crest of Muldrow Glacier. It was three years before their attainment of the summit was verified by Archdeacon Stuck and his companions. This photograph, the only one in existence of this view, was taken in 1947



# DESERT FISHES—

## *Clues to Vanished Lakes and Streams*

How the mapping of present-day fish distribution in American deserts gives unmistakable evidence of now vanished drainage systems

By ROBERT R. MILLER

*Museum of Zoology, University of Michigan*

*Photographs by the author unless otherwise credited*

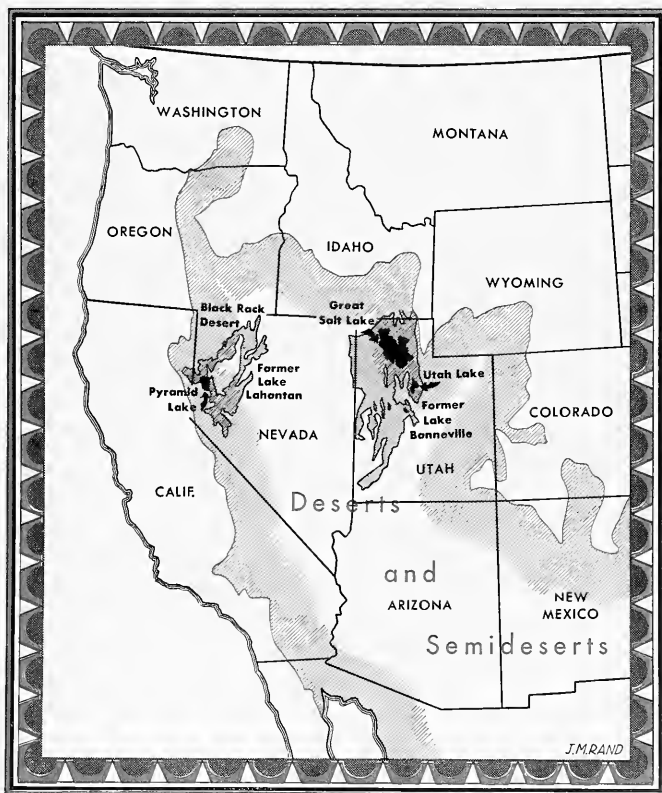
ONE spring day in 1936, I set out on one of the first of many strange and fascinating fishing trips. My route took me not to mountains, valley, or seashore but to the very heart of the Mohave Desert, an arid expanse of nearly waterless country lying along the eastern border of California. I tried to convince my friends that I was not seeking fossils but expected to catch living fishes in the desert. One can hardly blame them for thinking that such an unorthodox venture was slightly mad. Yet today we know that even in Death Valley, the hottest region in the Western Hemisphere and (with the possible exception of the Atacama Desert in Chile) the driest one, small, brightly-colored fishes dart about in the briny waters of Salt Creek, 250 feet below sea level.

The popular belief that deserts are barren wastes, devoid of most forms of life, is a natural conclusion after observing these regions from a speeding car or train window. Mile after monotonous mile of sun-baked, nearly treeless plain stretches endlessly into the dis-

tance, and the only desire of most travelers is to cross it as quickly as possible. Such casual observers are therefore much surprised to learn that deserts support abundant

populations of small animals, particularly rodents and lizards, and that these are sometimes more numerous in this inhospitable land than they are in areas of comparable size in well-watered, humid regions. They are even more amazed to discover that fish life is a characteristic and highly significant element of desert faunas.

The Hollywood version of a desert—a vast expanse of shifting sand dunes—falls far short of the actual physical make-up of most deserts. Even the Sahara, most famous of sandy deserts, is only about one-tenth sand. A desert is characterized chiefly by high summer temperatures, scarce and irregular rainfall, low humidity, and generally a high average wind velocity. There is usually a rather meager but very interesting and highly specialized flora. Deserts are regions of great extremes. For example, at Bagdad, on the central

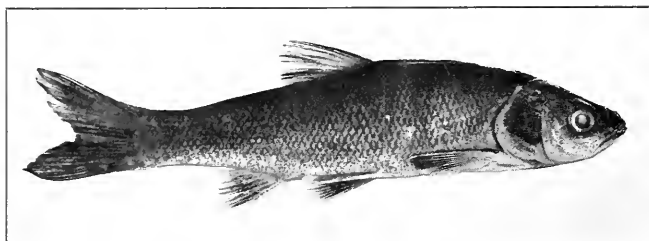


➤ 10,000 TO 30,000 YEARS AGO, climatic conditions permitted the formation of valley glaciers in regions that are now desert. Lake Lahontan and Lake Bonneville then covered parts shown here. Today only small vestiges remain



▲ EVEN DEATH VALLEY, the driest place in North America, has its floods: the Amargosa on the loose

Photo by Clarence Flaten



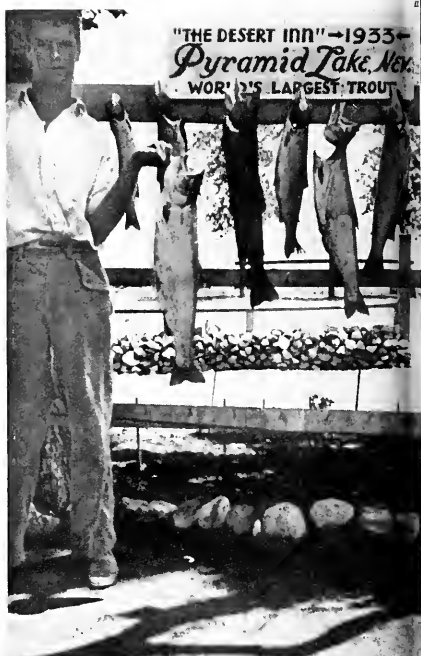
▲ WHEN a fish of this type is found in springs or creeks, there is reason to believe that the region formerly contained a fairly large body of water. *Sipbaletes obesus pectinifer*, a fish adapted to lake life

Mohave Desert, there is a record of three consecutive years without a trace of rain! Heavy downpours occur sporadically in small areas, however, and such cloudbursts may bring as much rain in a few minutes as would normally fall in an entire year.

The world's record for daily change in temperature is held by the desert— 26 degrees F. to 126 degrees F. in 24 hours in the Sahara. The highest known shade temperatures are also held by deserts— 134.1 degrees F. in Death Valley and 136.4 degrees F. at Azizia, south of Tripoli. The extreme dryness and the remarkable clearness of the air contribute to the great daily fluctuations in temperature. Dust-free air produces amazing deceptions of distance, and since there is usually nothing in the bare landscape to give scale, the desert explorer quickly learns to have great respect for distances.

Scarcity of permanent water is an outstanding feature of deserts everywhere. In the early days of exploration, particularly during the gold rush stampede of 1849, the desert took frequent toll of the lives of man and beast, and it even does so sometimes today, although the dangers are now comparatively insignificant. The uninitiated must beware of camping in any innocent-looking dry wash, for cloudbursts in mountains 50 miles distant often bring disaster. Damage by floods, strange as it may seem, is a characteristic occurrence in deserts.

The desert regions in western United States vary from the extreme aridity of Death Valley, with an average annual rainfall of slightly more than one inch, to the less torrid, elevated valleys of the Great Basin. Our American deserts include nearly all of Nevada, Arizona, Utah, and New Mexico, southeastern Oregon, southern Idaho,



▲ FISHES are the last thing the average person expects to find in the desert. But the largest western trout ever caught was hooked here—a 41-pound cutthroat. The largest fish in this picture weighs 12 pounds

eastern and southeastern California, and parts of Washington, Wyoming, Colorado, and Texas. In all of this thirsty region, irrigation farming is a necessity, for the annual average rainfall is only about ten to twelve inches. The Great Basin, which includes most of the area lying between the Sierra Nevada of California and the Wasatch Mountains of Utah, receives its name from the fact that its streams disappear into sinks, from which their waters evaporate, or they flow into lakes without outlet to the sea. It is a region of interior drainage—hence the allusion to a basin.

Over 100 years ago, when Fremont first explored the region, the "basin" was believed to be completely rimmed by mountains. It was soon discovered, however, that the Great Basin really consists of a series of parallel valleys, usually with independent drainage, sepa-



rated by steep mountain ranges extending generally in a north and south direction. It is the present-day distribution of the fishes of these isolated valleys that provides a key to the past history of the waters of this arid expanse.

The desert regions of the West support nearly half of the known kinds of fresh-water fishes native to western North America north of Mexico. Some of them are as

unique in the fish world as the remarkable saguaro, or giant cactus, is in the plant world.

Blind fishes, underground rivers, and bottomless springs are favorite topics among desert folk. These popular desert myths are often foisted upon the unwary "city tenderfoot," but they are also an attempt to explain how living fishes came to inhabit the desert. No authentic blind fishes have been

discovered in the fresh waters of western North America. Should anyone have reliable information as to the occurrence of such fish, the author would greatly appreciate receiving this information. But how did fishes of any sort get there? That is the question repeatedly asked but rarely answered. The story of how the old Indian squaw fell into a bottomless spring in Nevada and reappeared in Death Valley is part of the lore of the desert. But don't believe anyone who tells you that this is the way the present fishes of the desert reached their isolated springs! We must study events of the great Ice Age if we are to discover the true explanation.

These creatures crossed the now parched sands separating the iso-

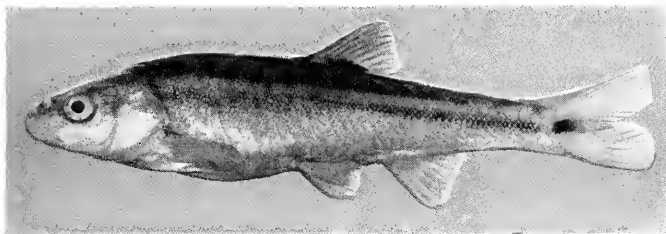


Photo by Clarence Flaten

▲ ONE OF THE OLD ASSEMBLAGE of fishes that inhabited the White River drainage basin: *Moapa coriacea*, which now lives only in the Moapa River, which drains into the north arm of Lake Mead



▲ ABOUT 20,000 YEARS AGO, the White River flowed through southeastern Nevada to join the Colorado River. Today it dies in the desert far to the north

➤ ARROWHEAD CANYON, through which the White River of Nevada formerly flowed—now a dry gorge. It once served as a thoroughfare for fishes that today are restricted to scattered water holes



➤ A FISH that can live in water over 100 degrees F.: *Eremichthys acros*, known only from a few hot springs and creeks along the edge of Nevada's bleak Black Rock Desert

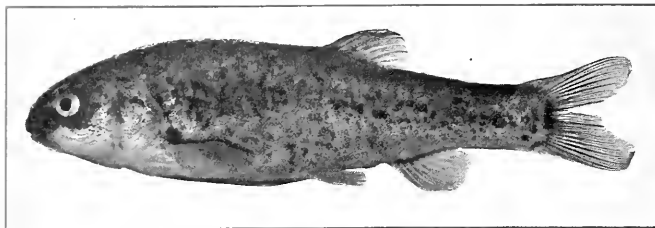


Photo by Clarence Flaten

▼ SARATOGA SPRINGS in Death Valley, home of fish that have survived in the desert since the Ice Age



▼ A REMARKABLE FISH only an inch long that lives in a pool 50 feet below the surface of the land, near the eastern edge of Death Valley. Practically all the individuals of this species in the world can be viewed at one time

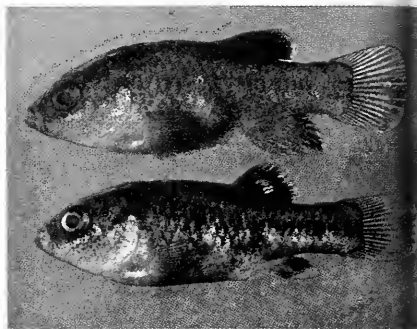


Photo by Clarence Flaten

lated springs and creeks when the desert was a well-watered land. They did not arrive as eggs on the feet of aquatic birds traveling from one isolated water hole to another. Such an occurrence might possibly take place occasionally in humid lowland regions. But it takes more than the safe transfer of a single egg, or a dozen eggs, to establish a species. I have repeatedly attempted to establish desert spring fishes in natural waters by transferring hundreds of individuals, but I have so far met with almost complete failure. What chance would a few eggs have of surviving dehydration during even a short flight in the dry desert air? Furthermore, if such a means of transfer were effective, we would not expect to find the regular patterns of distribution that we see today.

Ancient shore lines, which you may have noticed cutting dramatically across the mountainsides in

Utah and Nevada, look as real as though the waters that formed them had vanished only yesterday. The evidence for the former existence of these lakes is as convincing as the evidence for the Ice Age, and geologists believe that the two phenomena happened almost at the same time. The present distribution of desert fishes is in harmony with and often augments the conclusions of geologists about these ancient lakes and streams. As shown on the accompanying map, some of these inland seas, such as Lake Bonneville in Utah and Lake Lahontan in Nevada, rivaled our present Great Lakes in size and depth. Geologists believe that these lakes existed during the last great advance of the continental glaciers of eastern North America, when the climate of the Great Basin was cool enough to permit the formation of valley glaciers and to allow precipitation to exceed evaporation. This may

have taken place some 10,000 to 30,000 years ago. With the shrinking of the glaciers, the ancient waters gradually contracted until all that now remain of Lake Bonneville and Lake Lahontan are a few remnant lakes such as Great Salt Lake, Utah Lake, and Pyramid Lake. In many other basins nothing is left but so-called "dry lakes" or playas, which may occasionally hold water for a short period after floods. These are the regions where perfect mirages are encountered, and the traveler often cannot say with certainty whether the lake bed is wet or dry until his car actually crosses the playa.

With the drying up of these Ice Age lakes, the fish fauna became segregated as one valley after another was isolated by the receding waters. The relationships of the now separated springs and creeks is, however, readily determined by a study of the remnant fish life. This is possible because

the fishes inhabiting the ancient drainage systems, such as those of Lake Bonneville and Lake Lahontan, are distinctive for each basin. Thus, for example, in sampling the fish life of a disconnected creek along the border of Nevada and Utah, an ichthyologist found Bonneville types and predicted a former Bonneville connection before he knew where the stream in question drained. He then traced the stream bed down, and it soon dipped below the great terraces of Lake Bonneville, thus confirming what his sample had already told him. When the ichthyologist discovers closely related fishes in a chain of isolated springs or creeks, he knows that these now separated waters are remnants of a former integrated drainage; and when he finds only dissimilar fishes in closely adjoining basins, he has evidence that the waters of these basins have not been connected within recent geological times.

Hand in hand with the disrupted physiography of the Great Basin, consisting as it does of dozens of isolated valleys, the fishes are found to fall into more or less unrelated groups. The larger of the separate drainage basins, such as those formerly occupied by Lake Bonneville, Lake Lahontan, and the Death Valley system, show a fairly rich variety of fishes. But most of the smaller isolated basins contain only one to three species, if any. Some of the characteristic types of fishes that inhabit these desert regions are illustrated in the accompanying photographs. The chubs belonging to the genus *Siphateles* are widespread in creeks and springs of the Great Basin and live under a wide variety of physical and chemical conditions. The kind shown in the photograph is of a type that inhabits lakes, to which it is well suited because its oblique mouth is adapted for surface feeding and because its numerous gill rakers serve as a sieve for straining the abundant minute organisms (plankton) from the water. When we find a fish of this type in a river or spring, we may logically suspect that a large lake or lakes formerly

existed in the area, and often at no very remote time.

Mummified fish remains buried by early Indians help us to reconstruct the landscape upon which these aborigines gazed. Thus, studies of mummified *Siphateles* excavated from Humboldt Cave, Nevada, tell us that when the ancient Indian culture flourished, the adjacent Humboldt Lake, now an alkaline flat, was a permanent body of fresh water.

Another minnow, *Eremichthys acros*, is known only from a few hot springs and creeks along the edge of Nevada's bleak Black Rock Desert, one of the most desolate regions in the West. This fish enjoys the distinction of tolerating one of the highest water temperatures of all the known North American minnows<sup>3</sup>—over 100 degrees F. *Eremichthys*, meaning "desert fish," is presumably a living remnant that antedates even ancient Lake Lahontan.

Approximately 20,000 years ago the White River of southeastern Nevada, whose waters are now absorbed by the thirsty desert, was a tributary of the Colorado River. As long ago as 1891 an ichthyologist, Charles H. Gilbert, came to this conclusion, for he found fish in this now isolated drainage belonging to a kind previously known only from the Colorado basin. It was not until 22 years later that his logical deduction was fully substantiated, independently, by a geologist who traced the dry channel of the old river all the way to the Colorado. The imposing gorge through which the waters of the Ice Age White River flowed on their way to the Colorado is pictured on page 449. It now lies in the midst of one of the most parched areas in Nevada, standing as mute testimony, supported by the distribution of the White River fish fauna, for the former continuity of the ancient river.

One of the several distinctive fishes of this old fauna is *Moapa*,

<sup>3</sup> The terms minnow, chub, shiner, dace, all refer to fishes of the minnow family, Cyprinidae. They should not be confused with the common names of top minnow, desert minnow, or desert sardine, which have been used for members of the killifish family, Cyprinodontidae, a group only distantly related to the Cyprinidae.

which now lives only in Moapa River, a tributary to the north arm of Lake Mead from the Nevada side. Like *Eremichthys*, *Moapa* is a survivor of greatly restricted distribution, for it is known to occur only in the Moapa hot springs and the warm portions of their outflows, in temperatures varying from 87 degrees to 90 degrees F. Moapa River is the terminal flow of the old White River, which had its source about 175 miles to the north in the White Pine Range west of Ely, Nevada.

Turning to the family of killifishes, we find a number of unique types inhabiting the springs and creeks of the Death Valley system. This system once formed a continuous drainage from Owens Valley, at the eastern foot of the Sierra Nevada, to Pahrump Valley, which lies along the Nevada-California boundary east of Death Valley.

A remarkable dwarfed species, *Cyprinodon diabolis*, inhabits an equally remarkable spring hole in Ash Meadows, near the Nevada border. Devil's Hole, as this unusual spring is appropriately named, lies about 50 feet below the land surface and appears to represent a water-formed cave, the roof of which has collapsed. The descent into the hole is a sheer drop on all but the western side, where one can scramble down the walls of a narrow, rocky crevasse. The clear pool of deep blue water is without apparent inlet or outlet, and its depth is unknown. It has a constant temperature of 93 degrees F. Nearly the entire population of this species, which attains adult size at a length of less than an inch, inhabits a rocky ledge, approximately eighteen feet long and a few inches to two feet deep, at one end of the pool.

Since all of the individuals of this odd little fish may be seen at one time, a very close estimate of the total population is possible. In December, 1938, I estimated that there were only 50 to 75 individuals, but in July, 1938, at least 400 fish were present. The unusually small total population of this species has evidently been a potent

*Continued on page 475*



A GEM of resplendent beauty will shine in the western evening skies this December to thrill observers all over the world. On Christmas Eve it will glow in the twilight like a symbol of the Star of Bethlehem that shone nearly 2000 years ago. Indeed, it is entirely possible that this is the very same "star" that guided the Wise Men to the manger at the time of that first Christmas. Many earthbound observers will suppose that this light marks the top of some new beacon tower erected to guide aircraft. Flyers will depend upon the formula of its movements to determine their latitude and longitude. Thousands will contact observatories and planetariums to ask about it. Some will even view it with mixed feelings of wonder and fear until they are assured that it is harmless.

Public reaction to such phenomena is always interesting. It often runs the gamut from intelligent curiosity, through superstitious wonder, to fear and panic. But once people become acquainted with the true explanation, these things take on an added interest that sometimes opens the way to a new world of enjoyment. History reveals that

# Evening Star

By ROBERT R. COLES

*Associate Curator, Hayden Planetarium,  
American Museum of Natural History*

many of our greatest astronomers were inspired to begin their careers by some similar sight in the heavens. While we cannot predict that this sight of Venus will bring to light any future George Ellery Hales or Harlow Shapleys, it will most certainly set many thousands to thinking about the wonders of the universe, and we hope that some of these may accept the challenge to become better acquainted with our neighbor worlds.

Venus appears as the brightest object in the heavens, with the exception of the sun, moon, and an occasional comet. Being one of the two planets that circle the sun inside the earth's orbit, it behaves differently from Mars, Jupiter, or Saturn, which move on orbits outside that of the earth. Like Mercury, the other planet that is nearer the sun than we are, it shuttles back and forth from the morning to the

evening sky but is never seen in the midnight sky.

There will be no possibility of mistaking Venus this December when it blazes forth high above the southwestern horizon, against the background of stars in the constellation of Capricornus, the Sea Goat. It will dwarf every star in that part of the sky, its nearest rival being the planet Jupiter, which will appear near by but less brilliant. Early in the month the two planets will appear relatively near together, and on December 6, Jupiter will lie directly north of Venus by a distance of about four times the apparent diameter of the full moon. On the evening of December 22, the beautiful crescent moon will be seen near by and a short distance to the south of Venus. The next evening the moon will have shifted about thirteen degrees farther east and will continue to separate farther



**The Christmas season this year brings an unusual opportunity  
to view the brightest planet in the heavens**

from the planet each night as it grows toward its first quarter phase.

Like so many sky wonders, this one can be enjoyed for only a short time. Venus will attain its greatest brilliance on December 26, and during the remainder of the year and the early weeks of 1950, it will rapidly disappear in the evening twilight. On January 31, it will move into the morning sky and for a few weeks be lost in the dawn. After about a month, however, early risers may find it shining above the eastern horizon as a beautiful "morning star." We will not see it again as an "evening star" until the spring and summer of 1951.

This planet is one of the most interesting and mysterious members of the solar system. It sometimes approaches within about 26 million miles of the earth, which is closer than any of the other major planets ever come. When you see it in the Christmas sky it will be about 39 million miles away—nearer than Mercury can ever come and closer than Mars will be for several years.

Due to its brilliance, this planet has attracted attention since before the dawn of history. When they saw it in the morning sky, the ancient Greeks called it Phosphorus. But they knew it as Hesperus in the evening sky. Few if any then recognized that they were viewing the same planet in different parts of its orbit.

Through the years astronomers have learned not only how it moves in its orbit but also much about its physical characteristics. At the same time, Venus, like the clever lady that she is, has been eminently successful in keeping the star doctors guessing about many secrets.

In 1610 Galileo Galilei, professor of mathematics at the University of Padua, studied Venus through his telescope and discovered, for the first time, that it went through phases like the moon. But he also observed that its apparent diameter changed with the various phases, which was different from the way the moon behaved. When Venus appeared at the new phase (like a new moon), its diameter was

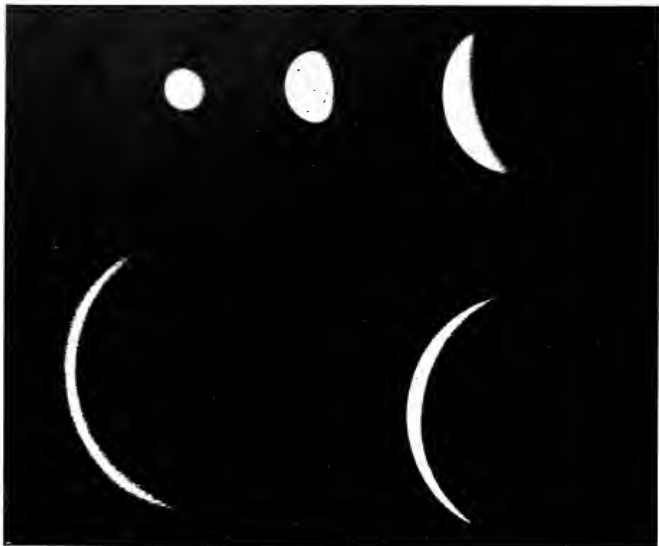
about six times as great as it appeared when near the full phase. This proved that it was sometimes closer to us, sometimes farther away. It also proved that its path around the sun lies completely inside the earth's. Otherwise, it would appear largest at the full phase—in other words when the earth lay between the sun and Venus. It was the first actual proof of the famous theory of Copernicus, that all the planets revolve around the sun. Since Galileo's time the orbital motion of Venus has been determined so well that astronomers can predict its future positions with a very high degree of accuracy.

Having a diameter of about 7580 miles, which is only slightly less than that of the earth, it has been called our twin planet. But, as we shall see presently, the likeness ends with the similarity in size.

Since Venus approaches nearer than any of the other planets and is so conspicuous in our skies, we might presume that the astronomers would know more about it than the others. Unfortunately, however,

this is not so. Amazing as it seems, man has never looked upon the surface of Venus. Even his most powerful telescopes and sensitive photographic equipment cannot penetrate far into its dense atmosphere. But despite their failure to

*Photo by Lowell Observatory*



▲ TO THE UNAIDED EYE, Venus seems to vary greatly in brightness. The telescope reveals that it actually appears six times as large at some times than at others. But it also goes through phases like the moon, as indicated here

see the surface, our astronomers have made several interesting discoveries concerning the nature of its atmosphere, and from these they have surmised what it may be like beneath the clouds.

Not only is the atmosphere very

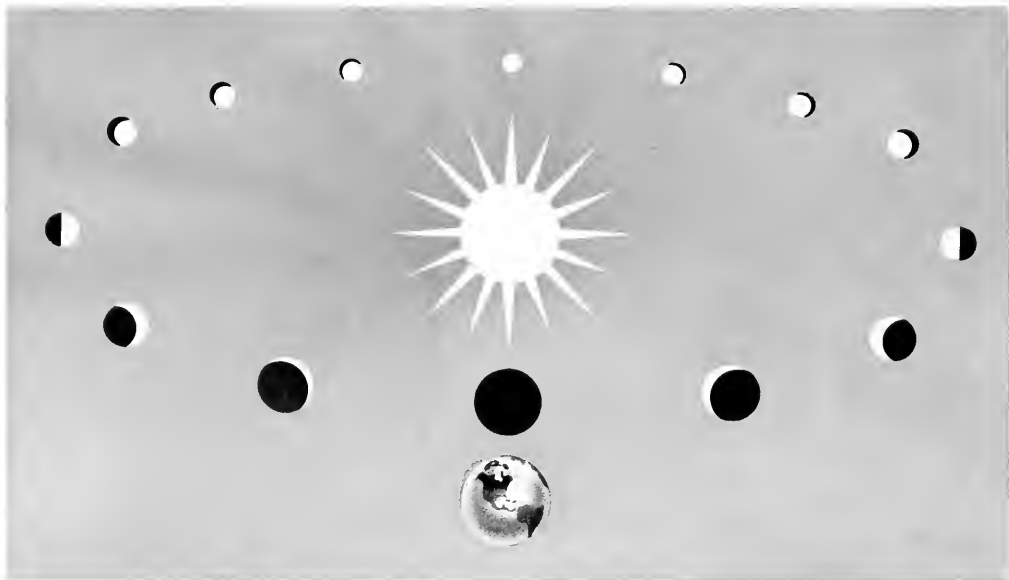
dense but it extends for several miles beyond the surface of Venus, so that by direct observation we can only study its upper levels. Spectroscopic studies conducted at Mount Wilson reveal that this upper atmosphere contains little if any free oxygen and practically no water vapor, both of which are essential to the support of life as we know it on the earth.

Investigations by Pettit and Nicholson have indicated that the temperature on the sunlit side of Venus is between 120 degrees F. and 140 degrees F., while on the darkened side it is around -9 degrees F. We know that there is little water vapor in the higher levels of our atmosphere, and temperatures in the stratosphere are considerably lower than those indicated in the upper atmosphere of Venus. This might suggest that conditions on the surface of Venus would be more favorable for life than at first seems possible. But further investigations disprove this theory.

Spectroscopic studies, conducted

▼ BECAUSE VENUS appears largest when it is in the crescent phase, Galileo deduced that its orbit must lie completely within the earth's path around the sun

*Drawing by Museum Illustrators Corps*





by Adams and Dunham at Mount Wilson in 1932, reveal a great abundance of carbon dioxide in the atmosphere of the planet. Indeed this compound seems to be the main constituent in those levels that can be photographed.

While it is true that we cannot view any of the surface of Venus, improved photographic methods using film sensitive to infrared light have permitted the astronomer to obtain pictures to some depth below the outer levels of its atmosphere. And these have revealed some interesting things.

Photographs taken on film sensitive to ultraviolet light show indistinct shading in the upper atmosphere that seems to indicate continually changing form. This suggests great turbulence in the high clouds. But pictures made on plates sensitive to the infrared show a more or less steady haze below the far outer regions of the planet's atmosphere.

Because of the impermanent nature of the markings in the outer regions of its atmosphere, it has been impossible to learn the rate at which Venus may rotate on its axis. With most of the planets this can be found by noting the time required for some conspicuous landmark to reappear as the body turns on its axis. But this method is impossible with Venus due to the absence of well defined and conspicuous markings. As a result, astronomers are at a loss to know the length of its day. Were it comparable to our day it is certain that the spectroscope would reveal the period. Every indication suggests that it is much longer than 24 hours, and many astronomers believe that it requires about 30 of our days to complete one rotation. Since Venus completes its circuit around the sun in 225 of our days, this suggests that it may have not more than about 7 days to the year!

When we consider what conditions may prevail below the cloud layer, we are dealing not with observational evidence but with theories. And while the conclusions are based upon apparently logical

reasoning, there is some disagreement among astronomers as to the over-all picture. Even the same authority may sometimes revise his views in the light of new evidence.

In 1940 H. Spencer Jones, the Astronomer Royal of England, wrote a fascinating and authoritative book entitled *Life On Other Worlds*, in which he discussed what was then known about the physical conditions of the planets and the question as to which, beside the earth, might support life. In the first edition of this book Dr. Jones concluded that, due to the great blanketing effect of carbon dioxide in the atmosphere of Venus, plus the fact that it receives much greater solar radiation than we do, its surface temperatures must be much above those that prevail on the earth. He suggested in that first edition that they are not much below 100 degrees C., the temperature at which water boils. Considering these high temperatures and the apparent lack of oxygen, he ruled out the possibility of either plant or animal life. However, he did picture great oceans and swamps on the planet and suggested a humid atmosphere. He went on to say that the conditions on Venus may be similar to those that prevailed on the earth in past geological times. He suggested that, as the sun cools and the environment changes, life might perhaps evolve on Venus to the level of intelligent beings.

In a recent edition of the same volume, we find that Dr. Jones has revised his theories. He tells us that, due to the apparent absence of water vapor in its atmosphere, we can hardly expect to find oceans on the surface of Venus. Nor can there be lakes or rivers but only an extensive and monotonous desert. He explains the atmospheric haze as the result of violent winds in the lower levels of the atmosphere. These storms, which he describes as much worse than anything we ever experience on the earth, churn up tremendous clouds of dust in the deserts and thus result in the haze that is revealed by infrared photography. He con-

tends that it is largely because of the scattering of sunlight by these clouds that we cannot see the surface of the planet.

He also surmises that, due to the so-called "greenhouse effect" caused by the heavy layer of carbon dioxide, temperatures at the surface of Venus must be even hotter than the boiling point of water. And he further states that we must not be too hasty in concluding that the evolution of the atmosphere on Venus will duplicate the trend followed by the earth's atmosphere, implying that life as we know it may never develop there.

Comparing these views, as expressed in different editions of the same book, we might almost conclude that they were written by different authors. Yet the man who penned them both is one of the most reliable and highly respected of our modern astronomers. He is not given to drawing conclusions without first considering every shred of available evidence.

This is a perfect example of how the science of astronomy advances. Every theory is considered as merely an approximation to the truth. Its survival is entirely dependent upon the interpretation of new evidence gleaned through the giant eye of the telescope, coupled with the camera and the spectroscope.

A second theory is almost always more dependable than a first, yet we cannot by any means be sure that the clouds are dust. Actually no astronomer knows for certain of what they are composed.

Whatever the nature of these clouds, we know that our sister planet Venus is hidden beneath a veil that must shut out the sun by day and the stars by night. Like some others of her kind, she revels in the adornment of her costume, glowing in splendor under the rays of her ruling sovereign—the sun.

As she dominates the evening sky this December, we may enjoy the full radiance of her beauty and leave to the star doctors the difficult task of solving the mystery of her true self.



A glimpse into the life of a Mexican medicine man,  
on the dusty trail from the Sierra to the sea

By GEORGE McCLELLAN BRADT

*Photographs by the author*

"THE Huichols adore water," wrote the explorer Carl Humboldt half a century ago. "Water first, and water last, is the consideration in all their ceremonies, the centre of their thoughts."

There has been little change among the primitive Huichols of Mexico's western Sierra Madre since Humboldt's day. Water is still the source of life. Without it in the form of life-giving rain there would be no crops of corn and squash and beans; and without

gourds full of sacred water from the caves of the river Chapalagana, from the clear springs of the distant *peyote* country, from even the far-away, shining Pacific there could be no rain-making ceremonies—and no rain.

Pilgrinages to the Pacific play an important part in the religious life of the Huichol. The salty sea water is especially prized, since the ocean is not only the birthplace of all the gods but the home of the golden sun who goes to bed in its

« "HERE," he said quite willingly. But he would not have his picture taken in the sun

blue depths each night. Although the way is long and hard from the pine-clad slopes of the *Sierra de los Huichols* to the subtropical, mangrove-fringed shores of the Pacific, many Indians make this yearly journey. At this very moment a solitary Huichol, clad in scarlet cape and embroidered trousers, is probably making his way on sandled feet down the six-day trail from the Sierra to the sea. Three or four colorful pouches hang from his shoulders, and he is wearing a wide straw hat decorated with hawk feathers and red cotton pompons. In his hand is a bow and a deerskin quiver of arrows. After sacrificing a number of beautiful ceremonial objects to the gods and the ocean, he will fill a few bottles with sacred sea water and begin the long trip back to his mountain homeland.

# Huichol



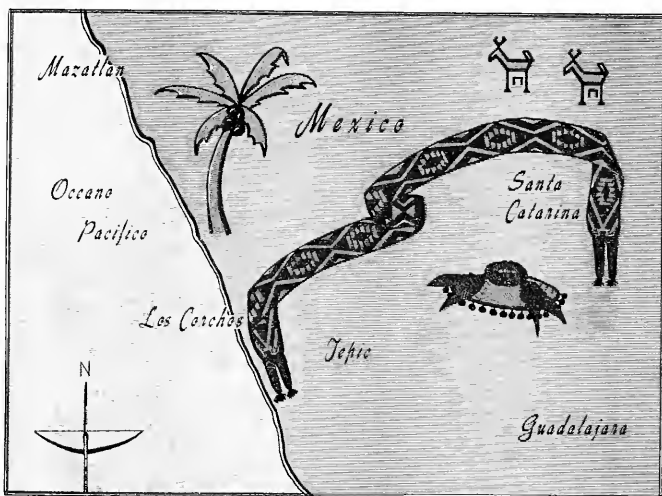
A few months ago my wife and I gave one of these pilgrims a lift in our truck. We were far south in the Mexican state of Nayarit, collecting insects for the American Museum of Natural History and trying to get from Santiago Ixcuintla to the coast. The sun was high, the day hot, and not a breeze stirred the palms and banana trees bordering the dusty road. It was one of those days that made us ask ourselves, "Why bugs and Indians and Mexico? Why not Maine and pines and the cold Atlantic?"—when, as usual, something turned up to make it all very much worth-while. The "something" was a wild-looking figure walking down the middle of the road ahead of us. It was our first Huichol.

When we caught up with the Indian, we stopped and offered him a ride. He quickly accepted, but before getting in gave me his hand and asked, "*Como amigos?*" After I had assured him we were the best of friends, he tried to get into the cab of the truck but was stop-

ped short when his bow got caught crosswise in the door. Only after he had unslung his bow and quiver, removed his amazing hat, and rearranged his water gourd, pouches, and razor-sharp machete was he able to get in with us.

During the next few miles we learned that he came from Santa Catarina, the most important of the six Huichol pueblos and the tribe's "mecca," across the Sierra in the state of Jalisco. He had been on the trail a week and was on his way to meet a friend already on the coast. After we had told him about ourselves and our work and had shared

a little meal of bread and cheese, I felt that we were well enough acquainted to ask him to pose for a few photographs, for which I promised to pay him. He readily agreed, and we drove off onto a side road to get the pictures. By this time we were quite conscious of what Lumbholtz felicitously described as "the distinct, though not strong" odor of the Huichol, which reminded him of "a wet dog, with the smell of smoke intermixed"; and we were ready for a little fresh air. Out of fairness to our passenger, I wish I had asked him his impression of his *gringo* friends'



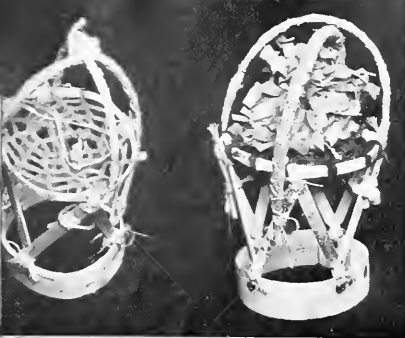
# Pilgrim



aroma—one which, after a hot week of bathless camping, was, I am sure, considerably "higher" than that of a smoky wet dog.

As soon as I stopped the truck, the Indian got out and walked off to sit in the shade of some low bushes. When I asked him to stand in the sun for the picture, he merely said, "*Aqui* (Here)," and refused to move from the shade. I was forced to take the photograph against a confusing background of

◀ THE INDIAN PILGRIM coming out of the sea with three bottles of the sacred water that he will carry to his mountain home for use in religious rites. On the beach are his ceremonial objects



▲ GODS' CHAIRS: the first of the sacred articles he threw into the sea. These are four-inch miniatures of the sacred seats in which the shamans sit when talking and singing to the gods



▲ TEN MEXICAN PENNIES decorate the inside of this votive bowl, along with squash seeds and corn. This also was offered to the gods—so that they might drink in the prayers of the people



▲ A PAIR OF "SHAMAN'S PLUMES"—feathered wands used by the medicine men when performing miracles—adorned his hat

green leaves. The Huichols have always been known for their independence. In fact, the Mexican ethnologist Carlos Basauri writes that, "Not for a moment will they admit that there is a race superior to theirs." There is none of the Tarahumara's shyness about the Huichol. The latter gives one the impression of knowing his rights as a man and an equal and of being prepared to stand up for them. When my model saw me start to put the camera away, he did not hesitate to ask, "And the *centavos* you promised me? I know you are going to sell my picture in your country." As I hastened to pay him he added, "I've been to Mexico City"—the Huichol equivalent of "I've been around."

Although we tried to acquire some of his beautifully made belongings, we had little success. After much pleading, he did consent to sell one small embroidered bag, but he emphatically refused even to consider parting with his handsome, woven woolen belt or with his fantastic, plumed, cart-wheel hat, saying, "*No puedo, no puedo* (I can't, I can't)."

It was not until several weeks later that we learned the probable reason why he would not sell us anything but the little bag. After comparing our notes and pictures with those in Robert M. Zingg's *The Huichols: Primitive Artists* and Carl Lumholtz' *Symbolism of the Huichol Indians*, we are convinced that our passenger was none other than a Huichol medicine man. Our photograph shows two peculiar bunches of feathers tied to wooden handles and fastened to the top of the Indian's hat. They are undoubtedly "shaman's plumes"—the sacred, feathered wands used by the medicine men to perform their miracles. No wonder he was unwilling to sell his hat. Perhaps most of his other belongings had religious significance as well. We were probably very lucky even to get him to pose for us.

As our distinguished passenger wanted to look around the near-by town of El Mango, we soon said good-bye, gravely shook hands, and

agreed to meet on the coast the following day.

By the time we reached the eight-mile beach at Los Corchos, we were so hot and tired that we forgot everything except a cool swim in the Pacific. In fact, over an hour passed before we thought of our Huichol. But he was there on the beach—almost as if waiting for us. We left the water and walked toward him to see what he was doing.

He was seated behind a large driftwood log, facing the sea, busily at work painting the finishing touches on a small wooden disc he was holding in one hand. Beside him were his pouches, machete, bow-and-arrow quiver and a long, narrow, woven basket. At the north end of the log an arrow stood upright in the damp sand. Another arrow, with a hawk's feather tied to the butt, had been stuck into the top of the log itself. When we passed the Indian, he did not look up but continued working on the little plaque. It was evident that the pilgrim was about to begin the immemorial Huichol sacrifice of symbolic, sacred gifts to the gods. We did not wish to intrude upon so obviously personal a performance, so we walked off down the beach to watch him from a polite distance.

Within a few minutes he rose to his feet, took several unrecognizable articles from the woven basket, and—fully dressed—waded into the blue-green water. Fascinated, we watched as he took two small, basket-like objects and threw them one at a time into the water with an underhand, sweeping gesture. At this point two little Mexican boys, naked and brown, splashed into the water to retrieve the offerings. Although the Indian insisted that they return them to the sea, they refused to do so and brought them to us instead.

In the hand it was easy to identify the little objects. They were Huichol "gods' chairs," miniature replicas of the sacred chairs in which the shamans sit when talking and singing to the gods. They were cunningly made of bamboo

and woolen yarn, probably by the pilgrim himself. The crossed arms of the chairs were covered with green and magenta tissue paper, and the seats had been fashioned of green and dark blue crewel. The holes in the base had apparently been burned through with a heated nail, and the various parts were held together with agave fiber string and yellow thread.

The second object offered to the gods was a small, shallow bowl. This was a sacred "votive bowl," the ordinary gourd drinking vessel of the Huichols decorated on the inside with kernels of corn, squash seeds, and ten Mexican one-cent pieces. According to Lumholtz, the votive bowls are "drinking-gourds offered to the gods who, so to speak, drink in the prayers of the people." In addition, there were two beeswax figures of deer, modeled in relief and embellished with tiny blue and white glass beads.

Then in rapid succession followed the remainder of the votive paraphernalia — the painted disc, several ordinary candles decorated with colored paper, three short ceremonial arrows, a little blue stick resembling the head of an animal, a second votive bowl, a tiny mat of fluffy blue and green wool, and finally the horns and upper jaw of a dried deer's head. By this time there were other spectators on the beach, and our little collectors were having stiff competition. They did succeed in getting us the arrows, wooden disc, and candles, but the second bowl and the woven mat fell to a young teacher from Mexico City, who would not part with the material but did let me photograph it.

The Indian then came out of the water, removed his hat as well as his long embroidered shirt and sandals, and returned to sit in the shallow water. This apparently constituted his ceremonial bath, for in about ten minutes he walked back to the log, picked up a toy-like, foot-long bow and a short prayer-arrow sticking in the sand, and waded out into the surf once more. He fitted the arrow to the bowstring and aimed it high into

the western sky. He did not shoot it, however, but simply threw it into the sea. This, too, was picked up by the teacher and was found to have a diminutive bow and pair of sandals tied to the shaft.

This completed the ceremonial objects that the Indian had brought to present to the gods in payment for the sacred water he had come so far to obtain. As a final act in the dramatic, ancient rite, he dipped a dark ear of corn into the salty water, returned it to the woven basket, and filled three little patent-medicine bottles, their labels still visible, full of sparkling sea water.

It was only when the Huichol brought the bottles out of the ocean that he offered any words of explanation. As he carefully put them away in one of the multi-colored pouches, he said in Christian Spanish, "*Agua bendita para la iglesia* (Holy water for the Church)," which in pagan Huichol would have meant, "Sacred water for the temple." He then collected his various belongings and left the beach.

When he had disappeared, we sat down to examine our collection more closely. Probably the most sacred items of all were the short prayer-arrows. Concerning these Lumholtz wrote, "Ceremonial arrows, a kind of messengers to the gods, are inseparably connected with the life of the Huichol. The sacrifice of one or more arrows expresses his desires in a language intelligible to him and to the gods . . . for the arrow stands for him personally, and for the tribe, praying its silent prayers." The teacher also brought his material, and we were surprised to find the small, woolly mat filled with the living larvae of the Larder Beetle. Perhaps the mat and its squirming tenants represented a prayer for the extermination of an imagined plague.

Sitting there on the lonely beach, the only sound the breaking surf, it was difficult to believe that the spectacle we had just witnessed had actually happened. There had been an unreal, dreamlike quality about the entire performance, almost as

*Continued on page 475*



▲ THE TUFTS OF COTTON represent rain clouds in the religious symbolism of a people who adore water in every form. Three deer and a bird are also discernible in the complex pattern of this sacred wooden disc



▲ CEREMONIAL ARROWS, used for communication with the gods. They are about one-half as long as the regular hunting arrow and are often decorated with miniature votive offerings



▲ THIS PRAYER ARROW, sacrificed by the pilgrim, had a tiny bow and a pair of sandals tied to its shaft. The votive bowl contains several beeswax figures, a bead design, a paper flower, and the usual cotton clouds



# SUGAR SEASON

## *in the South*

The arrival of winter marks the beginning of a picturesque home industry—the making of sugar syrup by methods handed down from early times

By LORUS J. and MARGERY J. MILNE

*Photographs by the authors*

▲ HIGH OVERHEAD, the grasslike tassels of sugar cane wave above many small cane patches scattered through the South

TALL, jointed sugar canes, swaying gently in the warm breeze, their floppy, narrow leaves rattling slightly under a graceful grasslike plume twelve feet above the ground, suggest nothing to attract a sweet tooth. Yet scattered through the old South and Florida are countless centers where these canes pass through a simple mill to release a flood of sugary sap. Cauldrons of the juice steam and froth until the water has boiled away and syrup or molasses is obtained. This is the southern counterpart of operations in New England's maple orchards—but with some startling differences. Chilly air and sledding snow are part of the northern picture. Balmy weather and the beginning of official winter are central themes in the warmer industry. February frosts terminate the cane sugaring just as surely as maple tapping ceases when sunny days in March introduce a buddy flavor into the rising sap.

Sugar cane begins to reach its ripe perfection toward the end of November, and whole families work down the rows of their sweet acreages to strip the slender foliage until only the sturdy, glossy stalks remain. Some are purple, some red, some striped with green; the various kinds are distinguished by this means. Each stalk bears at few-inch intervals slight ringlike swellings from which the leaves arise, much as does a bamboo pole. Soon the ripe ones are felled, and the stiff, solid, ten-foot lengths are piled in a truck or wagon to be hauled through pine-studded palmetto prairies to some sugar mill. Often the road is merely a pair of ruts in the sand, past poor land on which hump-backed Brahman cattle find grass among the coarser weeds. Before it reaches a black-topped highway, the trail may splash through swales where egrets, ibis, and herons wade among the water plants. Or it may brush through live oak thickets hung with gray wreaths of Spanish moss and set with "air plants" that are relatives of the pineapple but suggest instead great bird nests

built of hoary green leaves. These are but wayside parts of the vegetation that carpets great expanses and surrounds the richer islands of dark soil where sugar cane can thrive.

The little mills to which small growers take their canes still use the iron presses that have been handed down from the "yeahs befo' the wah." Only an ignorant damyankee would ask "Which war?"—there has been only one in these parts. But the mill is literally the center of activity. Around it runs a circular path about 40 feet across, beaten in the old days by the feet of a blindfolded mule. The animal (or its modern counterpart) pulls the end of a counterbalanced pole that lies across the mill and transforms the roundabout movements of the plodding puller into rotation of the mill's crushing drum. The iron throat of the machine—a vertical slot perhaps three inches wide and five inches high—accepts two or three canes at once and leads them to the revolving drum, which crushes them flat and then extrudes on its farther side a fibrous strand to represent each cane. This





▲ THE JUICE is crushed from the cane in a primitive circular mill turned by a blindfolded mule. Then it is cooked in the cauldron shown here

➤ THE FROTH frequently rises in the simmering pot and overflows down the iron ring set inside the rim. The liquid drains back into the cauldron through a crack, while the impurities remain at the top



sudden metamorphosis takes place all within a distance of a foot or so, while a sweet brown juice pours from the iron side through a spout that suggests in shape the outlet of an old-fashioned pump at a well. Who is there that is not eager for a glassful of the fresh squeezin's? Who would not roll on his tongue this new cane juice—many times as sweet as maple sap and just as distinctive in flavor?

Around and around goes the pulled end of the heavy pole. Within its counterclockwise circuiting, a man stands near the maw of the machine and feeds it canes picked from a pile laid parallel on the ground beside him. A small boy holds a bucket with a burlap strainer under the spout, while

others scamper across the circular path to draw away the crushed ribbons from the mill or bring more canes to add to the shrinking stock. When the pail is full, another takes its place, and the brimming bucket is carried to the wife and mother of the family. She lifts the burlap, squeezes it fairly dry, and dumps the painful into her cauldron. Over and over this process is repeated until the 60-gallon pot is almost full. Then the mill stops, for without refrigeration, juice that is not heated within an hour or so will spoil.

The kettle for boiling is imbedded to its rim at the middle of the bend in a U-shaped brick furnace built on the ground. A fire is started and fed through a square

doorway at one end of the horizontal U, with wood tossed in skillfully to produce most heat in the immediate proximity of the pot. The hot air, smoke, and fumes continue around the U under the cauldron to emerge from a chimney constructed at the other end of the furnace—right beside the fire door.

While the extracted juice is heating, the children scurry around and enjoy themselves. They girdle short lengths of cane with pocket knives, then snap the stalks and split them into mouth-sized pieces that can be chewed. Guinea hens explore the pile of cane beside the idle mill, to tear off pieces of the plant and snatch at sipping flies. The man of the family and the older boys chop wood and stack the pieces



◀ THE HOT SYRUP, cooked to proper consistency and color, is filtered through a cloth—and one more “round” is done

water are thrown in to cool the inner spaces, for if the syrup boils further “it’ll tear yo’ bread apart!” The bead vanishes. In the cauldron remains only a small dark concentrate from the original 50-odd gallons. It is ladled out with a larger dipper, into a tub covered with a clean cloth as a strainer. And as the last few cupfuls are removed, other workers stand ready with pails of water. Dashed into the kettle, the water dissolves the sticky coating before the remaining heat from below can dry it into a tarry mass. Washing the kettle proceeds with speed and enthusiasm. Everyone seems happy. One more “round” has been done.

This product is cane syrup, valued in local stores at a dollar-fifty a gallon and upward, depending on the reputation of the man who made it. He may express his personal preference by finishing each batch as “light,” “medium,” or “dark,” with the color and sugar concentration in rough correspondence. None of it is molasses—a still darker and more viscous fluid, whose heavy flavor is due in part to several hours of extra heating, which bring it to an almost water-free condition. Nor does cane syrup crystallize under ordinary circumstances. The plant materials that give it its rich color seem to help prevent this transformation. Usually the syrup is the end point of an agricultural art that lends flavor to hot cakes and to coffee, to homey cookery of every kind. Only the old-style mill, the cauldron, cans, and buckets must come from the outside world. For the rest, the skills of a man and his family suffice. Pioneering versatility still has its respected place where there are ready hands and ample time. Cold cash loses some of the glitter seen on city streets when syrup is on the fire—whether in the maple groves of New England’s hills or the cane patches of the deep South.

where they can be reached quickly when the fire needs fuel. There will be little more for them to do until the batch begins to steam.

Gradually the gallons of juice reach the boiling point, and glistening bubbles rise to the top to burst. Regulating the fire becomes an art, for the pot must be kept boiling without the upward surge of steam pushing the liquid over the side. Hour after hour the water turns to vapor and escapes. The foam becomes ten to fifteen inches thick, a seething mass of sparkling spheres that hisses quietly like a four-foot version of a freshly-poured glass of soda water. Impurities rise to the top and are skimmed away. This used to be a tedious, wasteful step in the process, since it was always difficult to remove the scummy bits without simultaneously losing syrup. Now the clearing of the broth is simplified by the installation of a false rim to the kettle—a ring of iron four inches high. The froth rises within the ring and overflows in little waves. As the bubbly stuff runs down the outside of the iron band, the gas escapes and the liquid drains back slowly

through the crack between ring and pot. All this takes place within the gently sloping edges of the cauldron, so that nothing escapes but steam. The scum accumulates where it can be scraped away with ease, between the true rim of the kettle and the circling iron band.

Soon larger bubbles appear through the froth, and their bursting makes broad holes for a moment deep into the bead. “The change has come,” and now the cook must watch with special care, waiting for the hot syrup to reach the concentration wanted. With a clean can fastened to a long pole as a dipper, the specialist (mill feeder, fire stoker, and now connoisseur!) reaches into the seething mass to raise samples that can be studied as they are poured back. Rapidly the color darkens, and the succeeding samples are thicker as they flow from the can. The last few trickles become cool enough to hang in strings from the inverted scoop. When they “hang real good” orders begin to fly thick and fast. Away comes the door to the furnace. Out come all the embers—raked into the open with frantic haste. Pailsful of

# The Disappearing Wings of the ROVE BEETLE



An airplane with collapsible wings has challenged man's ingenuity in recent years, but the Rove Beetle perfected such an arrangement ages ago

By LYWOOD CHACE

CUMBERSOME wings that would hamper the insect when crawling in the grass are no problem for the Rove Beetle. Nature has provided it with folding wings that

are neatly tucked out of the way when not in use.

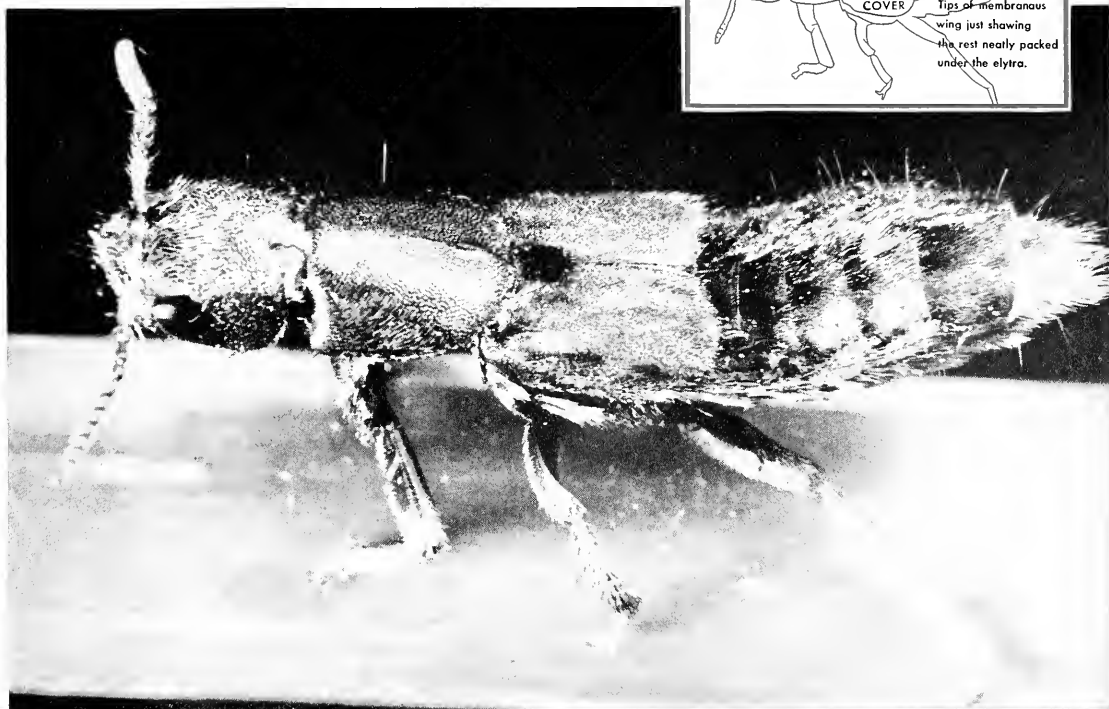
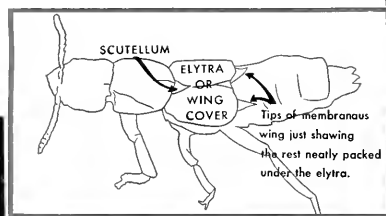
When the insect alights, the elytra, or wing covers, come back against the body, and the mem-

▲ THE ROVE BEETLE with wings extended for use when flying

branous wings are folded flat against the top of the abdomen. With the tip of the abdomen, the beetle then tucks its wings back under the wing covers.

In taking flight, the wing covers are lifted above the body. Almost faster than the eye can follow, the wings unfold and spread out—and the Rove Beetle is off.

▼ THE SAME INSECT with wings completely folded and neatly packed under the elytra, or wing covers. The diagram at right shows where the tips of the wings are just visible, projecting from beneath the wing covers



# Tuber Foods of the OLD INCAS

Who can say where these delectable vegetables might have traveled if they had attracted the same interest as the potato?

By WALTER HENRICKS HODGE

*University of Massachusetts  
Photographs by the author*

▼ LIKE A GIANT STAIRWAY to the sky, the spectacular Inca terrace gardens of Cuyo-Cuyo, Peru, tower above the tiny village nestling at 11,000 feet above sea level. On these old terraces, the tuber crops are still grown



▲ THE OPEN-AIR MARKET of a central Peruvian town regularly offers tubers for sale (ocas in right foreground) among other eatables

IN the Andean highlands of Peru, the Indians have a proverb that says, "Stew without *chuniu* is like life without love." In this way they express their esteem for several edible tubers which, though quite similar to the potato, have never spread into the world market. To sample the various kinds is one of the pleasures of traveling in those remote mountains. And when one realizes how important these tubers must have been in the growth of the ancient Inca empire, one becomes doubly interested in them.

There must be something about the Andean environment that has favored the evolution of tuber-producing plants, for no less than four important species in four very distinct genera have been grown there by the Indians since before Columbus came to America. One of this quartet, the familiar potato, has since wandered to many parts of the globe, to become one of the

most valued of all food plants, especially in temperate regions. In fact, the annual world production of potatoes much exceeds all the golden wealth taken out of Peru by the Spaniards. On the other hand, the potato's companions of the old Inca terraced gardens — those plants known in the Incaic Quechua tongue as oca (*Oxalis tuberosa*), ullucu (*Ullucus tuberosus*), and añu (*Tropaeolum tuberosum*) have remained in their highland homeland, unknown to the world in general though still important to the Indian populations.

Oca is most popular of the three today, with ullucu a close runner-up. In several widely separate districts of the Andes, in southern Colombia and southern Peru, the oca even rivals the potato in importance. The mist-shrouded village of Cuyo-Cuyo, which lies at the head of the Sandia ravine just east of the northern end of Lake Titicaca, is a most intensive center of oca culture. Here, beginning at 11,500 feet in the bottom of a narrow, steep-walled *quebrada*, ancient terraced gardens known as *andenería* rise tier above tier (some 150 of them!) on the precipitous mountainsides. One would have to hunt to find a more impressive display of old Inca terracing. Obviously, the valley has long been an important agricultural site. Many of the terraces are still in use, though some have been abandoned to pasture. Today, as undoubtedly five centuries ago, ocas and potatoes, and to a lesser degree ullucu and añu, are the principal crops grown.

Oca tubers are curious in shape, being slightly flattened cylinders, somewhat thicker than the thumb and averaging three to four inches in length. As in the potato, tiny scale leaves border upon the deep-set eyes. Belonging to the Oxalidaceae, the plant is a cousin of our smaller weedy sorrels and, like them, possesses reddish stems, clover-like leaves, and similar flowers whose orange-yellow petals are generally marked with fine purplish lines. The oca plant does not appear to set seed, a characteristic



▲ IN THE HEART of Tuber Land: a view looking down the valley near Cuyo-Cuyo. The introduced Australian eucalyptus tree shows its valued position as a source of timber and firewood in the important valley bottom. The little stream washes many a batch of "chuño-to-be"

not uncommon in species long propagated vegetatively by man. And so, like the potato, oca is reproduced by means of its tubers, which are cut into "eye"-bearing sections at the time of planting.

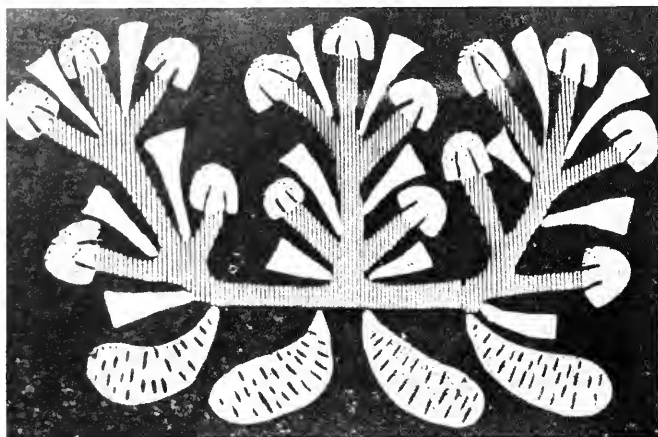
The Quechua Indians of Cuyo-Cuyo plant their oca at the beginning of the rainy period, which falls in August or September, but elsewhere in the Andes planting may be delayed several months depending upon when the rains arrive. The oca crop is treated exactly like potatoes, the plants being hilled up, with deep intervening trenches running down the slope. All the cultivation is by means of crude grub hoes or the primitive foot plow. Inca agriculturists practiced rotation of crops and fallowing, and so do their modern descendants. Thus the oca

plant is generally interplanted or rotated in following years with the other tuber plants, with cereals, or with the European broad bean. Between growing seasons, llamas and sheep are pastured on the terraces, thus aiding in fertilizing the soil. In Ecuador or Colombia, where the lower general elevation of the Andes permits, one often sees rows of corn planted alternately with oca.

Approximately eight months after planting, the tubers are mature, and during April and May whole Indian families, including even the children and grandparents—all decked out in their colorful handwoven ponchos and shawls—may be seen on the terraces harvesting the equally colorful crop.

The starchy oca tubers that they harvest are typical of the genus





▲ AN INDIAN PAINTING from before the time of Columbus proves that the Inca civilization knew the oca. Though stylized, the tubers are well shown, and the trifoliate leaves indicate the genus *Oxalis*

▼ HARVESTING OCAS: a Quechua boy, dressed like his father with homespun felt hat and woolen stocking hat, or *chullo*



▲ THE OCA PLANT, a cousin of our weedy sorrels, has reddish stems, clover-like leaves, and orange-yellow flowers

*Oxalis* is containing puckery crystals of calcium oxalate. Crystals are especially abundant in the bitter variety, and their presence makes it necessary to cure or ripen the tubers before they can be eaten. This is achieved by placing them in the sun for several days, after which the oca is sweet and can be eaten either raw or, more commonly, boiled in the stews and thick soups that constitute a basic portion of the serano's diet. After the harvest season, all Indian doorsteps in oca country each day sport a few mellowing and colorful ocas destined for immediate consumption. The tubers have a very pleasant flavor when so prepared and may remind one of boiled sweet potatoes, though others have likened their flavor to a cross between that of green corn and pumpkin. Ocas are also delicious roasted or prepared like candied sweet potatoes. The sweet varieties are sometimes split lengthwise and placed in the sun to dry to form a product called *cavi*, which is cooked slowly in a crude double boiler and afterwards eaten with honey or homemade cane syrup as a dessert.

Since tuber harvests come but once a year, the Indians of the high Andes have had to devise some way of holding their semiperishable crop





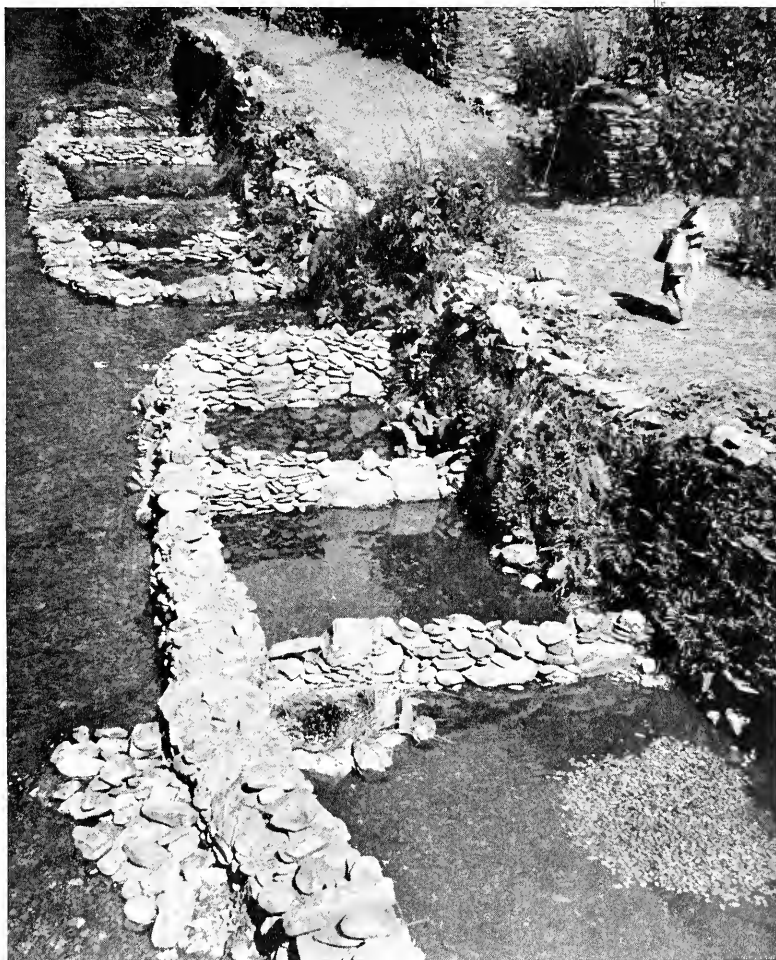
◀ TWO TYPES of dehydrated tubers, or chuñu: ullucu at left and oca at right. Desiccated tubers like these will keep indefinitely

▼ BEFORE the ocas can be dried satisfactorily, they must be soaked for three or four weeks. Pens like these are used extensively along the banks of the stream

through the year. Lacking controlled refrigeration, they adopted dehydration centuries ago. In desiccated form the tubers will keep indefinitely. The Quechua word *chuñu*, although perhaps originally applied to dehydrated potatoes, is now used for any desiccated vegetable.

Among the varieties of oca, as among the varieties of potatoes, the bitter type makes the best chuñu, and for this reason this variety is most popular and widely used. Bitter ocas earmarked for desiccation are, curiously enough, put in water immediately after harvesting and left to soak often for three to four weeks or until the eyes take on a purplish color. At Cuyo-Cuyo temporary pens of rocks are built along the sides of the swift glacier-fed stream that courses through the village, and during May and June quantities of tubers may be seen submerged in these watery bins.

After soaking, the tubers are spread out on straw in the open in any available area for about a week, usually at higher, colder sites. During this period they receive periodic freezing at night and drying by the intense sun during the day. At the end of this treatment, they are trampled upon to remove all vestiges of water. The wizened, thoroughly dehydrated oca product obtained by this procedure possesses



a flesh that is grayish-white in color. Bitter potatoes, when given the same treatment, are peeled and yield a chalky "white" chuño, while a "black" chuño can be obtained by skipping the preliminary water bath.

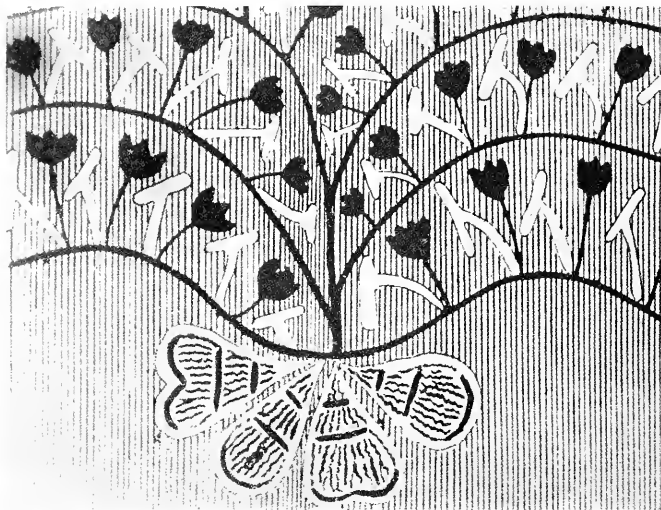
Chuño can be stored for long periods. Like most dried foods, it has to be soaked overnight before it can be cooked. In the *chupes*, or stews, that form the simple fare of the two-meal-a-day serrano, it forms a cherished addition, valued for its distinctive flavor.

The highland Indians of the Titi-caca area recognize at least ten varieties of oca. One of them, called *cjaya-oca*, is a popular bitter form with white tubers. It is used almost solely to prepare the chuño known as *cjaya*. Several forms of sweet ocas are also grown, all with tongue-

twisting aboriginal names: *sapallu-oca* with attractive yellow or orange tubers bearing red-margined scale leaves; *chachapea-oca* with grayish tubers; *paucar-oca* and *lluchico-oca* with red tubers; and *mestiza-oca* with white ones. Apparently the chief color variations are associated with floral differences, for it has

been noted that yellow ocas have long-styled flowers, while white ocas have medium-styled flowers and red ocas short-styled flowers.

Following ocas in importance are the tubers of *Ullucus tuberosus*, a plant belonging to the modest group of the Basellaceae. In southern Colombia and around Cuzco, Peru,

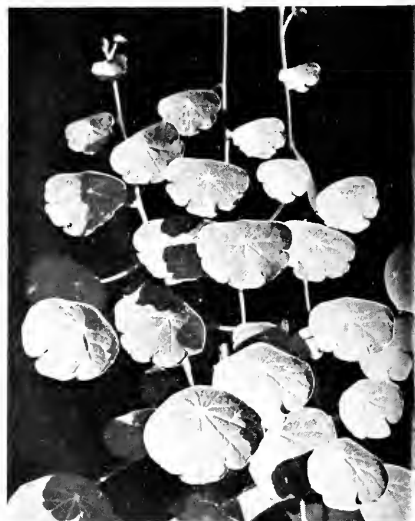


▼ A PENNY'S WORTH of añu, among a pile of the tubers, beckons prospective buyers to a stall in the Quito market. The vendor urged the author to buy them, stating they were especially good for bad liver or kidneys



▲ THE TYPICAL UMBRELLA-SHAPED LEAVES identify this plant as añu, not the similar oca. The vinelike habit of this "nasturtium" is also clear, and the tubers are recognizable. (From Tiahuanacan pottery from the Upper Nasca Valley)

▼ FROM THE LEAVES, one would immediately recognize the añu plant as a first cousin to the nasturtium



it is outranked as a crop only by the ever-popular potato and maize. This tuber plant has a variety of names in the Andes, but the most common of these are the aboriginal appellations *ullucu* (from which the Latin generic name was taken) and the apparently Spanish modification, *mellico*.

Tubers of ullucu often look like small potatoes, and the casual observer might easily pass them up as just another one of the many varieties of potatoes common throughout Andean South America. As with the oca, several color variations exist, the commonest one being a pale magenta form which has apparently suggested the Spanish name, *rojas*, applied in Bogotá. Plain yellow tubers are also seen, as well as a curious yellow form speckled with magenta spots. These color variants may be either shaped more or less like a potato or long and curiously curved. The Quechua Indians of the Urubamba region near Cuzco prefer the curved form and call it *chchucchanlisas*. In its upright branching form, ullucu resembles its garden associates, the

potato and oca. Its branches are similarly succulent and bear broad, heart-shaped, simple leaves, while the insignificant flowers are found on axillary racemes.

Ullucus are popular with the highland Indians for several reasons. In the first place, the plant is very resistant to frost, an important consideration in the altiplano. In fact, it excels all other Andean tuber plants in this respect. Thus it can be grown in a wider range of sites and especially at the highest elevations for crops. Secondly, any species that gives a high yield in tubers produced per plant seems always to be popular. In this characteristic, the ullucu appears to be better than the potato and oca. It does not seem to matter that the tubers, though numerous, are small. The sierra Indians, unlike North Americans or Europeans, are not apparently impressed by size alone. Numbers count! The ullucu has the same range of culinary uses as does the potato and may be prepared as a chuño as well.

It is curious that the tubers of the potato and ullucu are so similar, because the plants belong to entirely unrelated species. Even closer mimics are the tubers of the oca and añu, also unrelated. In fact, so nearly alike can forms of these tubers be that on one occasion I had to plant a questionable one in order to be sure of its identity! Tubers of añu seem to be slightly more conical than oca tubers, but the two are similar in their white to yellowish coloring, which is often mottled or striped with red or purple, especially around the eyes. In the fresh state, these tubers are

said to give off a somewhat disagreeable odor, making it impossible to eat them raw, as is done with certain varieties of oca.

Although the añu's tubers are sometimes difficult to identify, the flowers and leaves are not, for one would immediately recognize this plant as first cousin to the familiar garden nasturtium (*Tropaeolum majus*), which also claims the Andes as its native home. In fact, these two species are often found growing together in Andean gardens, one as a crop, the other as a weed. And *Tropaeolum tuberosum*, like your garden favorite, tends to be a herbaceous twiner, clambering and anchoring itself on other plants by its tactile petioles. In this way, it covers the area of its growth with its smallish, five-lobed, green umbrellas. The flowers are orange-red to scarlet and are smaller and less showy than the horticultural *Tropaeolum*.

The añu has never been as important a crop as the other species, but its tubers can be found in most Andean vegetable markets, for they can be prepared in the usual boiled form to add occasional variety to the food. The highland folk may be more interested, however, in certain medicinal lore surrounding this plant, for an Indian woman in Quito assured me that the cooked tubers are especially good for bad liver or kidneys! The chroniclers record even more unusual, if mystical, uses prevailing in their time. Both Inca Garcilaso de la Vega and Padre Cobo state that the Indians believed that the tubers exerted anti-aphrodisiacal properties when used as a food. However, Garcilaso affirms that Indian gallants could counter-



▲ TWO WIDELY DIFFERENT forms of ullucu

➤ A YOUNG ULLUCU PLANT growing in a garden near Quito, Ecuador



act this influence by "holding a small stick in the hand while eating the tubers." This magic property of a small stick must not have been generally known to the Inca's soldiery, because, according to Cobo, they were regularly fed this food during campaigns, on the Inca's orders "that they might forget their womenfolk."

This tuber trio produce their best crops in what may be called the potato zone, that is, in the Andean highlands lying roughly between 9000 and 14,000 feet. Such elevations are often subjected to nightly frosts. Even the day temperatures are cool, and during the rainy growing season, the plants experience a superabundance of misty and cloudy weather. However, the trio lacks the extensive latitudinal range of the potato, which in South America runs far south into Chile. Thus oca and ullucu are not found for any great distance south of the Bolivian highlands. Growing as they do close to the equator, with its almost equal days and nights, these species, like certain other equatorial plants, may not readily be adaptable to the long days of summer in the temperate zone.

Our forgotten tubers appear to have had their original home in the old Inca heartland around the high basin of Lake Titicaca. More varieties are recognized there, and a greater number of native names are applied. Moreover the fringes of this very region have supplied us with proof of their use in pre-Columbian times, for Andean tubers, like many other economic plants, served as pictorial motifs, chiefly on pottery, among the peoples of the old highland civilization. Since these cultures left no written records, such pictograms have indeed been our best evidence of the importance of these tubers in early days. From the Upper Nasca Valley at Pacheco, Tiahuanaco age pottery (pre-Inca) has been found with beautifully stylized colored paintings representing the *añu* and oca. Of the ullucu we are not so sure because of its general similarity (in tubers and foliage) with the potato. Inasmuch as this trio was grown only in the

moist highlands where stored tubers would soon disintegrate, no remains have been found in ancient highland sites, nor would one expect to find them preserved abundantly in the ancient tombs of dry coastal Peru. Yet recent studies of plant remains from coastal burial mounds show them as rare relics—apparently transported there in the form of *chuñu*. They are only recognizable through a careful microscopic study of the characteristic form of their starch grains, which differs in each of these species.

From the highland valleys of southern Peru, where we can guess their wild ancestors grew, the oca, *añu*, and perhaps ullucu were taken gradually northward. When, it is difficult to say. We do know that at the time of, or very soon after, the Spanish Conquest, these three plants were in cultivation in the fertile highlands of Quito, which at that time was the northern bastion of the Inca Empire. We are not certain, however, whether the ancient Chibchas of the northern Andes knew our trio. Possibly the plants moved into the highlands of Colombia and adjacent Venezuela after the Conquest.

Such indirect evidence as we have for this again comes from the chronology of the chroniclers. *Oxalis*, *Ullucus*, and *Tropaeolum* appear in the literature in that order, which is more or less the order of their importance as crops. Potatoes had been mentioned first by Oviedo in 1535; four years later Bishop Valverde of Cuzco, in a letter to his Emperor, first describes the oca; while the ullucu and *añu* do not appear in the chronicles until 1582, when they were recorded from the region of Cuenca in Ecuador. Indirect evidence of the northernmost extension of the tubers is presented unknowingly in the writings of Cieza de Leon who, telling in 1553 of a trip south through the Andes, fails to mention specifically any of our trio of tubers until after his arrival in Peru. However, near Ipiales (now on the Colombian-Ecuadorian frontier) he records that "the people grow an abundance of potatoes and 'otras raízes'

(other roots)." These "other roots" perhaps represent ullucus and ocas, which are grown very extensively in this area at the present time. More specific insight into the distribution comes from Colombia's famed patriot-botanist Caldas. Being a native of Popayán in southern Colombia, Caldas was presumably more than familiar with the crop plants of that country and especially with those occurring in the vicinity of his birthplace. Yet not until the early nineteenth century, when he made a trip overland to not-so-distant Quito, did he become acquainted with the oca, ullucu, and *añu*. He recognized ullucu as a species new to science and described it. In commenting upon it and its value to the local Indians he lamented that it, as well as the *añu* and oca, which were also popular in Ecuador, had not been introduced into his homeland of New Granada (Colombia). Thus if we are to believe Caldas, the tuber plants had progressed only as far as northern Ecuador by the end of the eighteenth century.

They have not and could not travel much farther. They have reached Venezuela and the end of the high Andes with their cool climate. But without the aid of man, they could not move northward into the highlands of Central America. That they were not grown by the ancient civilizations of Middle America may be explained, no doubt, by the same reason that kept the potato so long at home in South America: tubers deteriorate rapidly in the tropical lowlands, and until the event of rapid transport, they could hardly make the long jump to the Middle-American highlands.

This has been unfortunate, for although these plants may not merit comparison with the potato except in their superior keeping qualities, they do possess qualities that would make them a welcome addition in the diet of any tuber-eating folk. And who can tell how the world might have come to regard these little-known plants had they received the wide distribution and careful selective breeding that was accorded the potato!



BIRDS not actively engaged in family duties escape the heat by making long flights to cool mountain lakes



# Refugee Pelicans

## OF THE DESERT

Far from their usual haunts, they struggle to raise their young beneath blazing skies on the transient islands of Salton Sea

By LEWIS W. WALKER

*Photographs by the author*

COYOTES, roadrunners, and rattlers are to be expected in the desert that lies between the southern California coastal range and the muddy Colorado. They are an integral part of this torrid belt of shifting sand. However, this land has not always been reserved for them alone. Water birds such as

pelicans, geese, and cranes formerly frequented the area, as is shown by bits of charred bone excavated from the refuse heaps of the Indians that once camped on the shore line of ancient Le Conte Sea.

This sea nestled in the bottom of a tremendous sink or depression that is thought to have had no

outlet and to have been fed intermittently by the mighty Colorado. Whenever the big river changed its course and dumped directly into the Gulf, evaporation caused Le Conte Sea to shrink. But even to the present day the ancient shoreline levels remain plainly visible, although the waters that etched them vanished many centuries ago.

Prior to 1900, some early California subdividers visualized parts of this ancient lake bed as ideal for the growing of all-year crops, so the waters of the Colorado were diverted to supply irrigation needs. For a few years all was serene. Then unprecedented floods from Arizona's normally peaceful Gila River overtaxed the crude dams, and the full force of the Colorado spilled once more into what is now known as the Salton Sink. Two years later, when the raging torrent was finally controlled, a lake about 80 miles long by 35 miles wide was left in the heart of the arid Colorado Desert.

During the two years of uninterrupted flow, several species of fishes as well as beaver and muskrat were carried to this below-sea-level spot, and they thrived on the spreading rushes and willows. Within a few seasons, birds commenced to settle on the body of water, and now it is the winter home for several species of geese, countless ducks, and 500 or 600 little Brown or Sand-hill Cranes.

Birds on migration that usually nested in more temperate zones looked over the shores and the tiny islands of silt at the southern end,



★ HAVING GROWN ACCUSTOMED to the cameraman's blind, the pelicans were easily studied and photographed

► THE DILIGENT PARENT somehow recognizes its own chicks and feeds them on regurgitated fish. The common complaint that these birds are serious competitors of the fisherman is erroneous

▼ NEWLY-HATCHED PELICANS look like gobs of partly melted salmon-colored wax. There is little hint that they will grow into the bird whose bill "can hold more than his belly can"



and a few tarried to raise their young. These pioneers were queer types to be seen in the heart of a desert. Cormorants, which are more at home on wave-swept coasts, moved in and utilized the dying tops of the flooded desert trees. Grebes or hell-divers settled in the clumps of fast-growing tules, along with bitterns, coots, and rails. Even Gull-billed Terns, normal residents of the Atlantic Coast and the Gulf of Mexico, crossed to the Pacific and founded their only known western colony on these tiny islands

of silt—islands that they now share with the white pelican, one of the largest water birds found in the United States.

These giants, with a wingspread that sometimes reaches almost ten feet, do not lead the same life in this burning desert that they do in their cool northern lake country. There they are comfortable when sitting on their eggs to keep them warm. Here they waddle onto the near-by shallows every 20 or 30 minutes throughout the hottest part of the day. It is tempting to conclude that they bring water on their feathers to cool the eggs. After a few rapid dips, I have seen them go back to the exposed eggs and appear to rub their dripping breast feathers over them. Then they seem to crouch over the nest to provide shade while normal evapo-

ration cools off the eggs. But that the bird is actually aware of providing a sort of "desert refrigerator" for the eggs will doubtless be questioned. Some will say that they simply go for a dip to cool themselves and that the rest of the performance is happenstance. In any case, one can easily feel the difference in temperature between eggs that have absorbed the sun's rays for a few minutes and those that the parent has just vacated.

During the months of June, July, and early August, birds not actively engaged in family duties escape the heat by making long flights to cool mountain lakes. About mid-morning the idle ones take off in a follow-the-leader formation, and the view of these fifteen or twenty must be alluring to others of their own kind. As they swing over the





islands, single recruits constantly join the air-borne procession, which soon starts to use the rising currents of warm air over the desert to gain altitude. Within a very few moments the hundreds of birds, stretching for about a mile through the sky, become mere glistening specks against the blue. A "now you see it, now you don't" effect is achieved at every banking turn. If the sun hits the white feathers at just the right angle, the birds are visible; but as they bank away they become lost.

High in the air they straighten the line and set off on a general westerly course. Perhaps from their vantage point they can see their destinations—the lakes and reservoirs that dot the higher elevations of San Diego's mountainous country.

Late afternoon brings their return. With black-tipped wings flexed and sometimes almost closed, they plummet to within a few hundred feet of the nesting islands and then, spreading their feathers, slow down and land in a conventional manner.

Newly-hatched pelicans are among the strangest of bird infants, both in texture and color. If a gob of wax with a decided salmon tint

were set under the desert sun and allowed to collapse, the resulting pile would be a good facsimile of these babies. Their skin has a translucent quality and is completely naked of both feathers and down. For the first few hours of their lives they are practically helpless, and they sprawl on the ground as though dead.

Within a week, however, a gray fuzz obliterates the sickly salmon tint and provides a shield from the sun's rays. About two weeks after hatching, the young gain the power of motion. From then until flight they wander all over the colonies and sometimes form into immense wriggling heaps in which each seeks the shade cast by his shade-seeking neighbor.

At mealtime, the onlooker is treated to the high-light show of the pelican colony. The parents, wandering aimlessly, are tackled by every famished fledgling, but these hungry young are usually shoved unceremoniously to one side. Finally, by some means, the correct offspring is identified and permitted to dine. After many awkward jabs, the fledgling hits the crack between its mother's mandibles and thrusts its bill far down into her throat. During this maneuver she is in the

midst of a paroxysm called regurgitation and is pumping predigested fish into her crop. The head of the fledgling remains submerged for many seconds. Then the mother, as though tired of the constant probing of her now empty gullet, shakes the infant loose. For a minute or more the gorged young one staggers about the colony as though drunk, either through fullness or possibly lack of oxygen. The reeling intoxication is always followed by a sudden stupor, and soon the young one, falling flat on its face, temporarily passes out of the picture.

If you were to walk toward a just fed fledgling, it would awake with a start and try to run. Generally, however, the food would act as ballast and keep its breast to the ground. But within a few seconds its stomach pump would go into action, and the slimy fish just devoured would be left in a pile by the fleeing youngster.

The range of these giant white pelicans has been sadly reduced in the last century. At one time small colonies existed on many lakes, but such large birds of glossy white are tempting targets to a certain class of sportsman. During the duck season in the region of Salton Sea, I have seen them shot down



▲ AFTER GAINING the power of locomotion, the chicks cluster in large wriggling heaps, each seeking the shade cast by its neighbor



➤ "I THINK I'LL TAKE A DIP." Every 20 or 30 minutes the hot birds waddle into the shallows of Salton Sea



▲ PERSECUTED BY GUNNERS in their more familiar haunts, the refugees make the best of it under desert conditions

▼ WHITE PELICANS are among the largest water birds in the United States. Their wingspread sometimes approaches ten feet

and left to rot where they fell. If such unwarranted wasting of life is questioned by a conservationist, he is given the old worn-out retort, "They kill sport fish." In eight weeks that I spent in the heart of these pelican colonies, I checked their foods at every opportunity. Carp, humpbacked suckers, and small mullet made up the bulk of their fare. Occasionally blue-gilled sunfish were brought in by the adults, but this was rare. The remains of bass were only detected three times in the hundreds of regurgitated fish that I examined.

Luckily, however, there are a few spots in the West where white pelicans are practically unmolested. But only a few of these breeding colonies are really sanctuaries where the birds are protected for their beauty and because their in-offensive nature is realized and appreciated. The advance of civilization has forced the birds ever backward, until now most of the dwindling colonies are in remote locations far from the haunts of man.



## HUICHOL PILGRIM

Continued from page 459

if we had imagined the return of a ghostly Huichol through five forgotten centuries to give us a flash back into the irretrievable past. The ceremonial objects we were holding—beautiful examples of the seldom seen symbolic, plastic art of the Huichols—were the only evidence of the Indian's recent presence.

The one thing that in any way marred the unforgettable event was the half-guilty feeling that, by depriving the gods of their rightful presents, we had possibly antagonized the devout pilgrim. But when we read in *Unknown Mexico* that even should a collector take away

ceremonial objects, "the Indians, though of course annoyed, would fear no evil consequences for themselves, since they had performed their duty," we felt considerably better. Actually, "the matter would have to be settled between the god offended and the offender, who would be punished with illness or accident." And the Huichol would have his already unshakeable faith in the omnipotence of his gods even further strengthened could he but have seen us within five hours of his departure. My wife was well into the first attack of malaria with a fever of 106 degrees—punishment enough for being an accomplice in the appropriation of the gods' sacred gifts!

## DESERT FISHES — CLUES TO VANISHED LAKES AND STREAMS

Continued from page 451

factor in its evolution, for any changes (mutations) appearing in the population would be rapidly assimilated through close inbreeding of the few individuals. There is evidence, now being tested, that the Devil's Hole fish has become so highly adapted to the warm temperature of its environment that it cannot survive at temperatures much cooler than 85 degrees F.

Death Valley supports two kinds of *Cyprinodon*, inhabiting salty creeks and a warm spring on the floor of the valley. *Cyprinodon nevadensis* differs considerably from *diabolis*. It is larger in size and possesses pelvic (belly) fins and, in the male, a black-bordered tail. Also, the scales are larger. This fish inhabits the saline, terminal flow of Amargosa River, which rises near the old mining town of Beatty, Nevada. The name Amargosa is from the Spanish, meaning bitter—a most appropriate description of this artery of brine and alkali running through the desert.

In Railroad Valley, west of the headwaters of White River, lives the spring fish, *Crenichthys*. Although now separated by high, arid divides, it is evident that some sort of a waterway once connected Railroad Valley with the White River. Again fish distribution gives us the key to this deduction, for a

related species of *Crenichthys* is widespread in the old White River basin. The nearest living relative of *Crenichthys* is another relict, *Empetrichthys*, a fish confined to the Death Valley system. It inhabits springs and their outflows in Pah-rump Valley, just across the Nevada border from Death Valley, and in Ash Meadows, along the California-Nevada line. None of these killifishes reach a length much greater than three inches. The occurrence of *Empetrichthys* in Pah-rump Valley and Ash Meadows (of the Amargosa River basin) testifies to a former hydrographic connection between these now isolated regions, although geologists have yet to supply the confirming physiographic evidence. Members of this genus were once thought to be closely related to a killifish inhabiting Lake Titicaca and other high Andean lakes, but the resemblance proved to be only a superficial one.

*Cyprinodon* is known elsewhere in the West only from the lower Colorado River basin, in Arizona and Mexico. Thus the presence of this genus in the Death Valley system forces me to conclude that there was once a surface connection between the Death Valley system and the Colorado River or its antecedent. Such a connection has been suggested by geologists. Now nearly 200 miles of scorched desert lie

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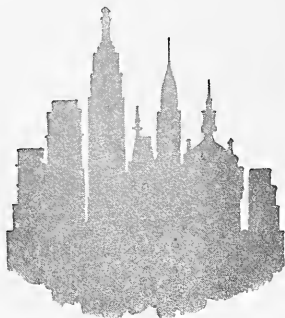
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between Death Valley and the Colorado, but a series of structural troughs, which once contained Pleistocene lakes, extends south and east from Death Valley. These troughs may represent the route along which the ancestors of the Death Valley species traveled. The connection was evidently an old one, however, for any trace of a connecting channel has been erased, and a fossil *Cyprinodon*, from Late Pliocene or Early Pleistocene beds in Death Valley, tells us that the genus inhabited the region perhaps as long ago as a million years.

The study of desert fishes is indeed fascinating. It not only helps in the reconstruction of the past face of the desert and in studies of the evolution of species, but repeated travels in the region bring one to appreciate the clean, vast expanse and singular beauty of the desert. The spell it casts over those who know it well is a bond not easily broken, and the saying "once a desert rat, always a desert rat" is well founded.

## BOOKS

Continued from page 439

than portions of some of the subjects in this ambitious work. Such sharp restriction is imposed by requirements of space that omissions naturally occur. I look in vain under Cytology (page 31) and Genetics (page 313) for any mention of polyploidy, a genetic phenomenon important in controlling the differentiation of many races of domestic plants.

The map on page 239 should be redrawn. Asia and Australia are shown therein united by "the comparatively shallow continental shelf . . ." It is well known that very deep water intervenes. On page 285 the statement is made that, besides the dingo and more recent man-made introductions, "the only other placental mammals in Australia are the long-flying (*sic*) bats." What about the numerous indigenous genera of rodents of Australia and New Guinea? At the foot of the same page comes the sentence, "There are marsupial MONKEYS (caps, the author's), but they have the unexciting appellation of tree kangaroos." Most mammalogists will agree that the word monkey, even in simile, should be omitted from the list of the Australian fauna. Anyhow tree kangaroos no more resemble monkeys than squirrels resemble marmosets. The recapitulation (page 376) of Wallace's views on faunal distribution in the East Indies may be worth-while. But surely some mention

ought to be made of the modern views regarding the relationships of Wallace's and Weber's Lines to the exposed continental shelves and the lowered sea levels of late Pleistocene time. Though the criticisms mentioned above are minor, all are perpetuations from the 1941 edition.

The book contains many excellent articles, among which may be emphasized the paragraphs and photographs illustrating bad and good soil treatment (pages 192-193). These ought to be engraved on the mind of every farmer in every country.

G. H. H. TATE

## SKYSHOOTING

----- by R. Newton Mayall and Margaret L. Mayall

Ronald Press, \$3.75  
174 pp., 59 illus.

IN *Skyshooting*, the authors prove their statement: "The real glory of the heavens lies not in what you see with your eyes, but what your camera sees." Excellently illustrated with photographs done by amateurs, this book describes how to make any camera reveal beauty in the sky which cannot be seen with the unaided eye. No telescope is required.

Of the many books written about astronomy, few have dealt with how to use a simple camera to photograph the stars. One can start by making star trails and learn such important things as proper exposure time, focal length of the lens, and how to make a scale to measure the angular distance between stars.

The reader who goes "skyshooting" will be tempted to watch the sky more closely. Aurorae, meteor showers, comets, variable stars, and novae all present photographic subject material. While some of these subjects are easy ones, others are more elusive and may be captured on film only after more tedious work. All offer some reward for the effort, comets in particular, for "If you discover a new comet your name will go down to posterity . . . for comets are named after the persons who discover them."

The authors do not spoon-feed their subject. Mathematics is introduced where it is required. If you want to make your own photographic atlas of the skies, you must progress from the making of trails to tracking the stars. Equipment must be built according to instructions in the text. Then the sun, moon, and remote galaxies will pose for the camera.

The usefulness of this book is amplified by a discussion of the work of clubs and organizations and specific advice on how one may participate in their scientific programs.

*Skyshooting* is a laboratory course in astronomy—the sky is the workshop, and any camera the equipment. It is clear that this book, plus the good photographic marksmanship which it will produce, offers its readers an excellent understanding of astronomy.

GORDON A. ATWATER



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